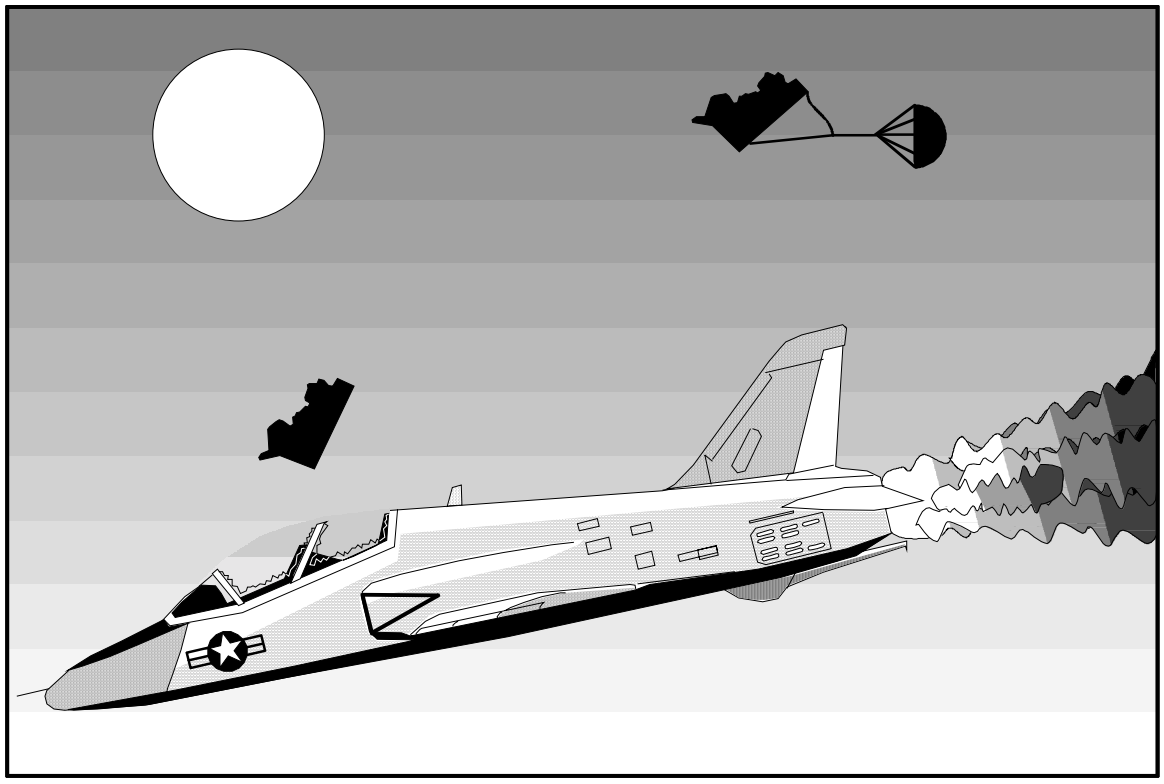
**NAVAL AIR TRAINING COMMAND**

**NAS CORPUS CHRISTI, TEXAS** **CNATRA P-1260 (REV. 9-98) PAT**

# EMERGENCY FLIGHT PROCEDURES



## LECTURE GUIDE

**1998**

# T-45C LECTURE GUIDE

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# LECTURE GUIDE
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# LECTURE GUIDE

**COURSE/STAGE:** TS, ADV & IUT Emergency Flight Procedures

**LESSON TITLE:** Start, Ground, and Takeoff Emergency Procedures

**LESSON IDENTIFIER:** T-45C TS, ADV & IUT EMFP-01

**LEARNING ENVIRONMENT:** Classroom

**ALLOTTED LESSON TIME:** 1.5 hr

**STUDY RESOURCES:**

* T-45C NATOPS Flight Manual, A1-T45AC-NFM-000
* T-45C NATOPS Pilot's Pocket Checklist, A1-T45AC-NFM-500
* Lesson Guides (Engineering) "Engine and Related Systems Malfunctions", "Hydraulic Subsystems Malfunctions", "CNI System Malfunctions"

**LESSON PREPARATION:**

Review:

* Part V, Chapter 12, “General Emergencies,” Part V, Chapter 13, “Ground Emergencies,” and Part V, Chapter 14, “Takeoff Emergencies,” T-45C NATOPS Flight Manual, A1-T45AC-NFM-000
* Associated procedures in “Emergency Procedures,” Pilot’s Pocket Checklist, A1-T45AC-NFM-500
* Lesson Guide, (Eng), “Engine and Related Systems Malfunctions”
* Lesson Guide, (Eng), “Hydraulic Subsystems Malfunctions”
* Lesson Guide, (Eng), “CNI System Malfunctions”

**REINFORCEMENT:** N/A

**EXAMINATION:**

The objectives in this lesson will be tested in EMFP 07X.

## LESSON OBJECTIVES

**1.5.1.4.7.1**
Recall comm procedures for ground emergencies

**1.4.2.9.3**
Recall procedures for clearing the engine

**1.4.2.11.1**
Recall procedures for no GTS start

**1.4.2.3.1**
Identify indications of no rotation start

**1.4.2.3.2.1**
Recall reasons for procedures for engine fails to start (no READY light)

**1.4.2.5.1**
Identify indications of hung start

**1.4.2.5.2**
Recall procedures for hung start

**1.4.2.4.1**
Identify indications of wet start

**1.4.2.4.2**
Recall procedures for wet start

**1.4.2.7.2**
Recall procedures for hot start

**1.4.2.9.2**
Recall procedures for high idle rpm on start

**1.4.2.1.1**
Identify indications of engine fire/tp hot on start

**1.4.2.1.3**
Recall indications of tailpipe fire on start

**1.4.2.1.4**
Recall procedures for tailpipe fire on start

**1.4.2.6.1**
Identify indications of bleed valve failure on start

**1.4.2.6.2**
Recall procedures for bleed valve failure on start

**1.4.2.8.1**
Identify indications of low oil pressure on start

**1.4.2.8.2**
Recall procedures for low oil pressure on start

**1.4.2.2.1**
Identify indications of GTS fire

**1.4.2.2.2**
Recall procedures for GTS fire

**1.5.1.4.1.2**
Recall procedures for engine fire/tp hot on deck

**1.5.1.4.1.2.1**
Recall reasons for procedures for engine fire/tp hot on deck

**1.10.5.3.1.2**
Recall procedures for fire on shutdown

**1.8.1.1.4.2**
Recall procedures for engine overtemp/overspeed

**1.5.1.4.3.2**
Recall procedures for wheel brake failure

**1.10.5.1.1**
Identify plane captain signal for hot brakes

**1.10.5.1.2**
Recall procedures for hot brakes

**1.5.1.4.2.2**
Recall procedures for nose wheel steering failure

**1.8.1.9.1.2**
Recall procedures for AV HOT caution light

**1.5.1.4.4.2**
Identify procedures for parking brake failure

**1.8.1.8.2.2**
Recall procedures for warning/caution/advisory light failure

**1.8.1.8.1.2**
Recall procedures for warning/caution audio failure (ON)

**1.5.3.1.5.5.1.1**
Recall situations requiring aborted takeoff

**1.5.3.1.5.5.2**
Recall procedures for aborted takeoff

**1.5.3.1.5.1.2**
Recall procedures for engine fire during takeoff

**1.5.3.1.5.2.2**
Recall procedures for aircraft failure to reach line speed

**1.8.1.1.7.2**
Recall procedures for engine overspeed

**1.5.3.1.5.3.1.1**
Recall indications for blown tire on takeoff

**1.5.3.1.5.3.2**
Recall procedures for blown tire on takeoff

**1.5.3.1.5.4.2**
Recall procedures for engine failure on takeoff

**9.8.1.15.2**
Recall procedures for aircraft settling off catapult

**1.5.4.3.1.1**
Recall indications of unsafe gear on retraction

**1.5.4.3.2**
Recall procedures for unsafe gear on retraction

## MOTIVATION

An emergency, by definition, is an unexpected occurrence that requires immediate action. However, the old expression: "Do something, even if it's wrong" doesn't apply here. Study this material, review NATOPS, practice in the trainer, ask questions, and discuss rationale. Satisfy yourself that you can respond to each emergency or combination of emergencies with confident, accurate checklist actions.

## OVERVIEW

The information in the EMFP stage will provide you with the knowledge necessary to handle emergencies and other malfunctions occurring from the time you start the engine until you land and shut down on the ramp. The EMFP stage consists of lectures, Computer Assisted Instruction (CAI) and Emergency Procedures (EP) simulator events. There are three CAI EMFP lessons that review and allow you to practice the emergency procedures taught in the lectures. In the simulator, you will put these procedures into practice in preparation for your first flight in the T-45C.

The goals of this lesson are to help you make swift and educated decisions for maintaining safe operations should you face emergencies during the start, ground, and takeoff phase of flight and to recall the proper procedures for those emergencies. To perform these procedures, you must first be able to identify them.

In the Engineering malfunction lessons, we said that you would learn the precise emergency procedures to follow in response to malfunctions later in the curriculum. Now is the time to do so.

This lesson presents emergency procedures occurring during the following phases of flight:

* Start
* Ground
* Takeoff

**REFRESHER**

Recall:

* System malfunction indications from Engineering stage
* Location and function of the warning panel, caution advisory panel, FIRE light, and MASTER ALERT light
* Plane captain signals

## PRESENTATION

NOTE: Procedural steps preceded by an asterisk (*) are considered immediate action items. You must be able to accomplish these steps without reference to the checklist.

*Sg 1, fr 2*
*Lesson Organization*

**START, GROUND, AND TAKEOFF EMERGENCY PROCEDURES**

* Starting emergencies/ malfunctions
* Ground emergencies/ malfunctions
* Takeoff emergencies

I. Starting emergencies/malfunctions

A. Comm procedures for ground emergencies **1.5.1.4.7.1**

1. Manage emergency before attempting communication

   NOTE: When managing critical emergencies on the ground, take care of the emergency and then, only if conditions and time permit, transmit intentions.

2. Report ground/deck emergencies on present operating frequency (i.e., ground or tower), using the following format: "Ground: [callsign] four zero zero with an engine fire on my line, shutting down"

3. Do not wait for reply to emergency transmission if situation requires immediate egress or shutdown of electrical power

4. If dual, communicate intentions to other pilot

5. Use hand signals or intercom system (ICS) to communicate with plane captain

B. If the throttle has been moved above cutoff with engine off:

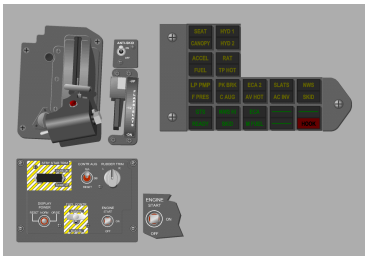
1. Clear engine procedures - See NATOPS **1.4.2.9.3**

2. Inspect engine and tailpipe before initiating another start

C. Abnormal starts

1. No GTS start **1.4.2.11.1**

***Sg 1, fr 3***
*No GTS Start*



**LESSON NOTES**

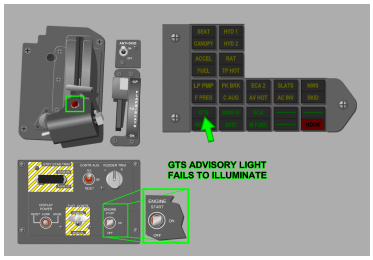
*Explain to your students that this is a top view of the throttle and is not to scale.*

a. Indications

(1) GTS cannot be heard

(2) GTS advisory light fails to illuminate within 20 seconds after the GTS start button is pressed

***Sg 1, fr 4***
*No GTS Start*



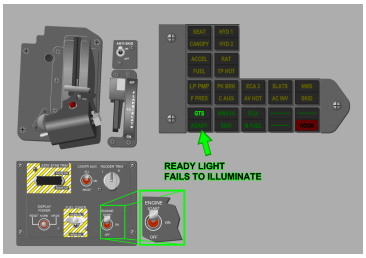

b. Procedure

(1) ENGINE switch - OFF

**CAUTION: To prevent overheating the DC starter motor of the GTS, allow a 3-minute interval between GTS starts and at least 30 minutes to elapse after 3 consecutive starts. Inspection of GTS exhaust duct, RAT doors, combustor section and removal of any residual fuel is required after any unsuccessful start.**

(2) Investigate cause of problem. Ensure that the start switches in both cockpits were on

***Sg 1, fr 5, 6***
*Engine Fails to Start*




2. No READY light **1.4.2.3.2.1, 1.4.2.3.1**

   a. Indications

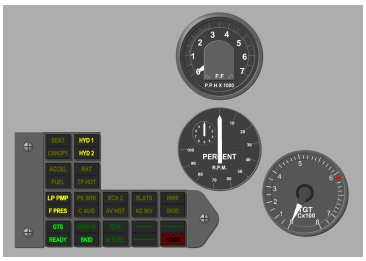
      (1) READY light fails to illuminate within 15 seconds

      **CAUTION: If the READY light does not illuminate within 15 seconds, discontinue start attempt, otherwise mechanical damage may result from an overheat condition. A tail wind may cause the $N_1$ compressor to rotate backward.**

   b. Procedure

      (1) ENGINE switch - OFF

***Sg 1, fr 7, 8***
*Hung Start*



3. Hung start **1.4.2.5.1, 1.4.2.5.2**

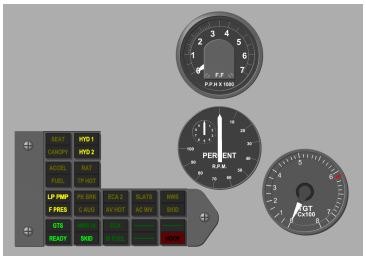
   a. Indications

      (1) Engine fails to accelerate from 45% to IDLE

      (2) EGT continues to rise after GTS cutout

   b. Procedure - See NATOPS

***Sg 1, fr 9, 10***
*Wet Start*



4. Wet start **1.4.2.4.2, 1.4.2.4.1**

   a. Indications

      (1) Engine fails to light off within 15 seconds of moving throttle to IDLE

      (2) Plane captain signals wet start

   b. Procedures - See NATOPS

***Sg 1, fr 11***
*Plane Captain's Signal for Wet Start*

5. Hot start **1.4.2.7.2**

***Sg 1, fr 12***
*Hot Start*

a. Indications

(1) EGT exceeds 550 degrees C

NOTE: The rate at which the EGT rises is a good indication of a possible hot start. Thus, a rapid rise toward the maximum limits in EGT should concern a pilot more than a start where EGT slowly peaks out at 550 degrees C. The EGT may exceed 550 degrees by 20 degrees for 10 seconds.

(2) Possible excessive fuel flow

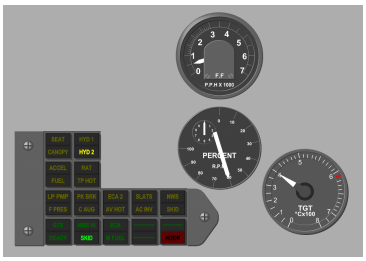
**LESSON NOTES**

*Discuss other causes of hot start.*

b. Procedures - See NATOPS

6. High idle rpm on start **1.4.2.9.2**

***Sg 1, fr 13***
*High Idle RPM on Start*



a. Indications: Idle $N_2$ rpm above limit of 57% (standard day)

NOTE: Add 1% for each 1,500 ft of altitude.

b. Procedures

(1) Consult Engine Idle RPM chart in NATOPS Pilot's Pocket Checklist for $N_2$ rpm limits for altitude and temperature

(2) If limits exceeded shut down engine

7. Tailpipe fire on start **1.4.2.1.3, 1.4.2.1.4, 1.4.2.1.1**

   a. Indications

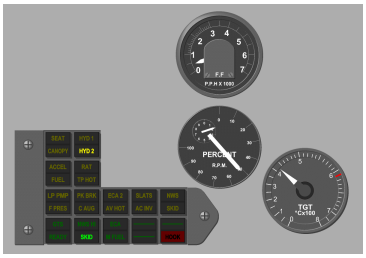
      (1) Flame appears in tailpipe during engine start

      (2) Plane captain signals tailpipe fire

      NOTE: In most cases a tailpipe fire will not illuminate either the engine FIRE light or the TP HOT caution light.

   b. Procedures - See NATOPS

***Sg 1, fr 14***
*Bleed Valve Failure on Start*



D. Bleed valve failure after start **1.4.2.6.1, 1.4.2.6.2**

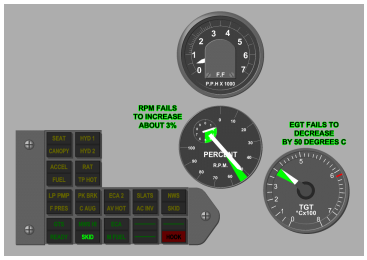
NOTE: When idle rpm has stabilized, the throttle should be advanced to approximately 70% (61 ± 4% needed to close the bleed valve) and then returned to IDLE. With the bleed valve closed, the engine rpm should be approximately 3% higher and the EGT approximately 50 degrees C lower than what was noted on engine start.

1. Indications (after throttle advanced to 70% and returned to IDLE)

   a. RPM does not increase approximately 3%

   b. EGT does not decrease by approximately 50 degrees C

***Sg 1, fr 18***
*Bleed Valve Failure on Start*




2. Procedures

   a. Reattempt to close valve by advancing throttle to 70%

   b. Return throttle to IDLE

   c. Monitor for increase in rpm and decrease in EGT

   d. If bleed valve does not close, shut down engine

**PROGRESS CHECK**

**Question 1 — 1.4.2.11.1**
**How much time should be allowed between start attempts to prevent overheating the GTS?**

ANSWER: To prevent overheating the GTS, allow a 3-minute interval between starts and at least 30 minutes to elapse after 3 consecutive start attempts.

E. Low oil pressure on start **1.4.2.8.2, 1.4.2.8.1**

1. Indications: OIL PRESS warning light does not go out at approximately 20% rpm

2. Procedures: shut down engine

II. Ground emergencies/malfunctions

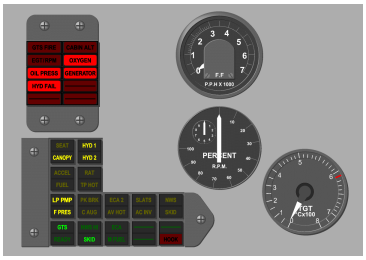
A. Emergencies

1. GTS fire **1.4.2.2.2, 1.4.2.2.1**

**?** **What are the indications of a GTS fire?**

ANSWER:
1. MASTER ALERT light flashes and warning tone sounds
2. GTS FIRE warning light illuminates

***Sg 1, fr 19***
*Low Oil Pressure on Start (1 Overlay)*



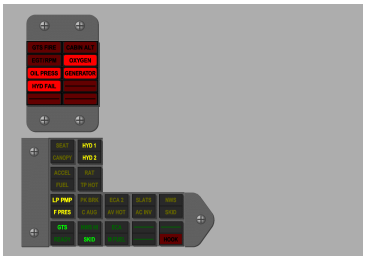
***Overlay 1***

***Sg 2, fr 2***
*Lesson Organization*

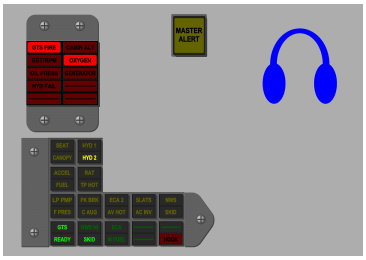
**START, GROUND, AND TAKEOFF EMERGENCY PROCEDURES**

* Starting emergencies/ malfunctions
* Ground emergencies/ malfunctions
* Takeoff emergencies

***Sg 2, fr 3***
*GTS Fire*



***Sg 2, fr 4***
*GTS Fire*




a. Indications

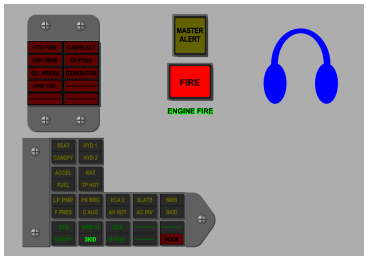
(1) MASTER ALERT light flashes and warning tone sounds

(2) GTS FIRE warning light illuminates

(3) Ground personnel giving fire signal and pointing to the GTS

b. Procedures - See NATOPS

***Sg 2, fr 5***
*Engine Fire*



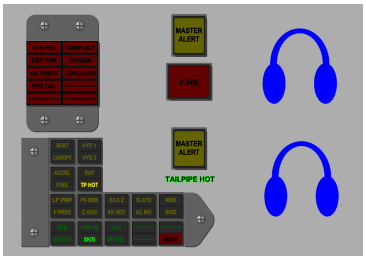

2. Engine fire or tailpipe hot **1.5.1.4.1.2, 1.5.1.4.1.2.1, 1.10.5.3.1.2**

a. Indications

**LESSON NOTES**

*Note that the procedures are the same for either engine fire or tailpipe hot indications.*

***Sg 2, fr 6***
*TP Hot*




(1) MASTER ALERT light flashes and

(a) With engine fire, warning tone sounds

(b) With tailpipe hot, caution tone sounds

(2) FIRE warning or TP HOT caution light illuminates

NOTE: To confirm an engine fire (in flight), secondary indications must be present. During ground or deck operations, assume that all warnings represent actual emergencies/malfunctions and proceed with the proper checklist. Do not wait for secondary indications.

(3) Ground personnel giving fire signal

b. Procedures - See NATOPS

c. Reasons for procedures: during ground operations, immediately shutting down the engine without verification may save the aircraft from damage

3. Engine overtemp/overspeed **1.8.1.1.4.2**

**?** **What is the maximum continuous engine operating temperature?**

ANSWER: 550 degrees C

NOTE: The probable cause of this malfunction is engine damage or uncontrolled fuel flow due to a malfunctioning engine control amplifier (ECA). If both lanes have failed, the ECA caution light will illuminate prior to the below-mentioned indications. Failure of one lane will illuminate the ECA advisory light.

a. Indications

(1) Start: EGT exceeds 550 degrees C (overshoot of 20 degrees for 10 seconds)

(2) Idle: EGT exceeds 450 degrees C

(3) Maximum (MRT): EGT exceeds 600 degrees C (30 minutes per flight hour)

***Sg 2, fr 7***
*Engine Operating Limitations*

**ENGINE OPERATING LIMITATIONS**

| Condition | Maximum $N_2$ RPM (%) | Maximum EGT (°C) | Time Limit |
|---|---|---|---|
| Military Rated Thrust (MRT) | 104 | 610 | 30 Min/Flight Hour |
| Transient / Acceleration | 104 | 645 | Less than 20 sec. |
| Maximum Continuous | 100 | 550 | - - - |
| Idle | 55 +/- 2 (Note 1) | 450 | - - - |
| Ground Start | - - - | 550 | (Note 2) |
| Airstart | - - - | 600 | (Note 3) |

1. Bleed valve closed. This nominal RPM increases 1% for every 1,500 feet above sea level and will vary depending on engine loading, air bleed, and ambient conditions.
2. Maximum overshoot of 20 degrees C for 10 seconds.
3. Maximum overshoot of 50 degrees C for 10 seconds (NOTE: The EGT/RPM warning light will operate at 650 +/- 8 degrees C)

(4) EGT/RPM light illuminates at 650 ± 8 degrees C or 112.4 ± 1% $N_1$

(a) MASTER ALERT light flashes and warning tone sounds

(b) EGT/RPM warning light illuminates

b. Procedures (ground operations) - See NATOPS

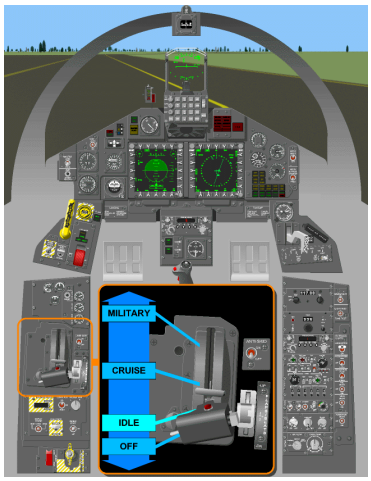
c. Hazards

(1) Possible fire

(2) Possible loss of thrust

4. Brake failure during taxi **1.5.1.4.3.2**

***Sg 2, fr 8***
*Brake Failure During Taxi*




a. Indications

(1) Lack of brake pedal pressure (one or both pedals)

(2) Aircraft fails to slow upon application of brake pedal pressure

(3) Aircraft pulls to left or right upon application of brake pedal pressure

(4) Low brake pressure (gauge)

b. Procedures - See NATOPS

*NOTE: An extended hook and/or external lights flashing in the ramp area indicate that a brake failure has occurred.*

*NOTE: In the event of single brake failure, use remaining brake and nose wheel steering to maintain directional control and to stop aircraft. Groundloop if necessary to remain on taxiway.*

5. Hot brakes **1.10.5.1.1, 1.10.5.1.2**

a. Indications

(1) Loss of normal braking action

(2) Smoke caused by excessive heat

(3) Plane captain signals hot brakes (by pointing at wheels and making fanning motion in front of face with other hand) or tower/ground control communicates problem

**LESSON NOTES**

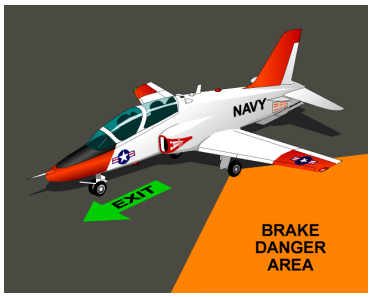
*Demonstrate the hot brakes signal or have one of the students demonstrate the signal.*

b. Procedures

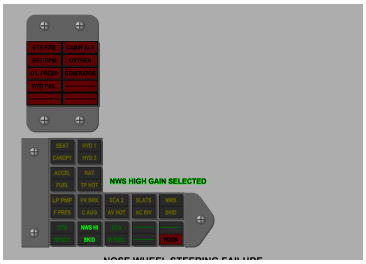
*When excessive braking has occurred (such as after an aborted takeoff), or hot brakes are suspected, notify the tower to alert the crash crew and to inform other personnel to stand clear. A dragging brake will also produce excessive heat at the wheel. A badly dragging brake could raise wheel temperatures to a point where the fuse plug (324 degrees F) will melt and deflate the tire. The time to reach peak temperature may exceed 25 minutes*

(1) Stop aircraft in a remote area or as directed by tower. Minimize use of brakes

***Sg 2, fr 9***
*Nose Wheel Steering Failure*




***Sg 2, fr 10, 11***
*Nose Wheel Steering Failure*




(2) Crash crew will check brakes and determine if cooling fans are required. If required, the aircraft will normally be shut down

*NOTE: Do not set the parking brake.*

*NOTE: If the aircrew elect to exit the aircraft, they should remain clear of the brake danger area by walking directly away from the aircraft in the direction of the nose.*

6. Nose wheel steering failure **1.5.1.4.2.2**

a. Indications

(1) MASTER ALERT light flashes and caution tone sounds

(2) NWS caution light illuminates

(3) Nose wheel fails to respond to rudder pedal commands

b. Procedures - See NATOPS

7. Emergency egress

a. Procedures - See NATOPS

**WARNING: Do not eject unless the canopy is fully closed.**

**WARNING: Before pulling the handle, lower the helmet visor, close eyes and keep the hands and body as far away as possible from the MDC pattern on the canopy.**

**WARNING: For water egress, pull the emergency oxygen actuator and do not disconnect the oxygen/communication hose. Inflate LPU after exiting the aircraft.**

B. Malfunctions

1. AV (Avionics) hot (ground indication only) **1.8.1.9.1.2**

   a. Indications

      (1) MASTER ALERT light flashes and caution tone sounds

      (2) AV HOT caution light illuminates

   b. Procedures - See NATOPS

2. Parking brake failure **1.5.1.4.4.2**

   a. Indications of failure to engage

      (1) Aircraft fails to hold in position with parking brake set

      (2) Wheel brakes operate normally, but parking brake does not set

      (3) No fluctuation on brake pressure gauge when parking brake handle is set

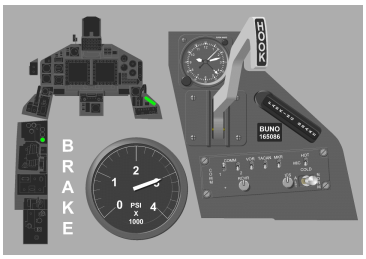
      (4) Brake pressure lights fail to illuminate

   b. Indications of failure to disengage

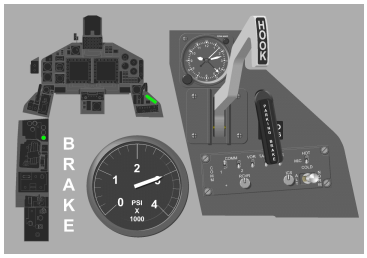
      (1) Aircraft does not roll easily when parking brake handle released

      (2) PK BRK caution light illuminates when handle is released and rpm above 70% throttle position

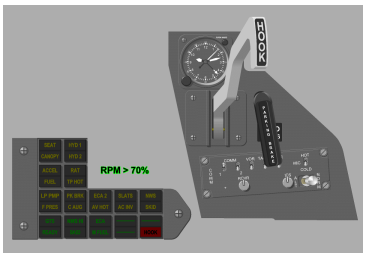
***Sg 2, fr 12***
*Parking Brake Fails to Engage*



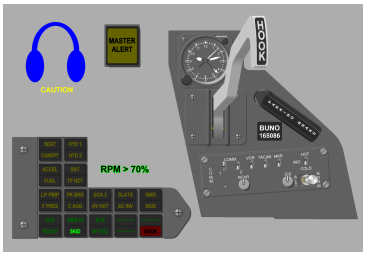

***Sg 2, fr 13***
*Parking Brake Fails to Engage*




***Sg 2, fr 14***
*Parking Brake Fails to Disengage*



***Sg 2, fr 15***
*Parking Brake Fails to Disengage*




c. Procedures

(1) Fails to engage: apply primary brakes to hold aircraft until chocked

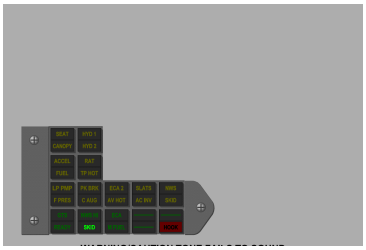
(2) Fails to disengage

(a) PARKING BRAKE - CHECK

i) If on taxiway, notify tower or ground of problem

ii) Avoid excessive power if normal thrust does not move aircraft

***Sg 2, fr 16***
*Warning/Caution Tone Fails to Sound with Confirmed Malfunction*



3. Warning/caution/advisory light or audio failure **1.8.1.8.2.2, 1.8.1.8.1.2**

a. Indications

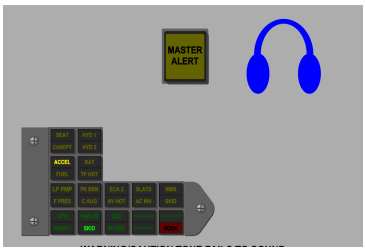
(1) Warning or caution tone sounds without an accompanying warning or caution light (uncommanded audio)

(2) Warning or caution tone fails to sound when a warning or caution light illuminates

(3) Warning, caution, or advisory lights fail to illuminate when other indicators show evidence of problem

(4) Warning, caution, or advisory lights illuminate when other indicators do not show evidence of problem

***Sg 2, fr 17***
*Warning/Caution Tone Fails to Sound with Confirmed Malfunction*



b. Procedures

(1) If lights fail to illuminate in presence of other indicators or illuminate without other indicators

(a) Set MASTER TEST switch to LIGHT TEST and verify all warning, caution, and advisory lights illuminate

(b) If possible, check aft cockpit lights to confirm light and system operation

NOTE: If the lamp test fails for some or all warning/caution lights, set the MASTER TEST switch to TONE TEST and confirm audio operation.

(c) Monitor indicator(s)

(2) Audio

(a) Uncommanded tone during ground operations

i) Test lights to confirm proper operation (MASTER TEST switch to LIGHT TEST)

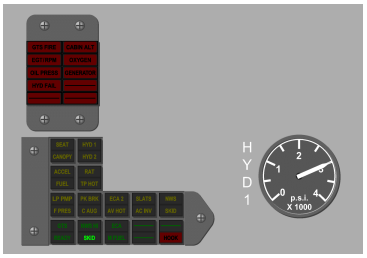
ii) If necessary, broadcast intentions and return to parking area with caution

(b) Uncommanded tones during takeoff

i) If failure occurs during takeoff, abort if practicable

ii) If not possible to abort, continue takeoff and land as soon as practicable

***Sg 2, fr 18***
*Warning/Caution/ Advisory Light Failure (1 Overlay)*




***Overlay 1***

iii) If required, turn up the volume on UHF/VHF

(c) Tones fail to sound

i) Set MASTER TEST switch to TONE TEST and verify warning and caution tone operation

ii) Monitor warning/caution advisory lights and appropriate indicator(s) closely

iii) If a warning or caution light illuminates without an associated tone, assume that the malfunction exists and land in accordance with the appropriate NATOPS procedures

**PROGRESS CHECK**

**Question 2 — 1.5.1.4.2.2**
**How should directional control be maintained in the event of a nose wheel steering failure?**

ANSWER: By using differential braking

**Question 3 — 1.5.1.4.3.2**
**What is the night signal for wheel brake failure?**

ANSWER: Lights - BRIGHT & FLASH

## III. Takeoff emergencies

*Sg 3, fr 2*
*Lesson Organization*

**START, GROUND, AND TAKEOFF EMERGENCY PROCEDURES**

* Starting emergencies/ malfunctions
* Ground emergencies/ malfunctions
* Takeoff emergencies

### A. Situations requiring aborted takeoff **1.5.3.1.5.5.1.1**

The decision to abort or to continue takeoff depends on many variables, some of which are predetermined and others of which are based on experience, feel, or reflex to immediate events. No rule will fit every situation. Sound judgment, knowledge of aircraft systems, and adherence to preflight briefing, NATOPS, operating regulations, and procedures will all play a part in recognizing situations requiring an aborted takeoff

There are many circumstances that may require aborting a takeoff. Some of these circumstances are unacceptable engine acceleration check, less than normal takeoff EGT/RPM, illumination of the FIRE warning light, trim failures, loss of oil pressure, fuel transfer failures, smoke in the cockpit, abnormally slow aircraft acceleration to takeoff speed, blown tire, uncommanded swerving, and loss of canopy. Early detection of an aircraft malfunction during takeoff roll is of primary importance

The decision to abort or continue takeoff must be based on the nature of the malfunction, aircraft speed, runway remaining, braking conditions, and whether or not the aircraft can become airborne prior to leaving the runway. To successfully carry out an aborted takeoff, the pilot must be aware of the location of the airfield facilities which may be at his/her disposal (arresting gear, etc.). Effects of winds must be considered

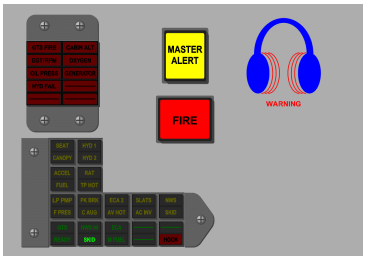
1. Abort

   a. Procedures - See NATOPS

2. Engine fire during takeoff **1.5.3.1.5.1.2, 1.5.3.1.5.5.2**

   NOTE: The FIRE warning light may illuminate momentarily. This does not indicate the absence of a fire. It could mean that a fire has burned the wires

*Sg 3, fr 4*
*Engine Fire on Takeoff (1 Overlay)*



***Overlay 1***

carrying the signals that enable the FIRE warning light. It could also indicate a malfunction (false indication) in the centralized warning system (CWS).

a. Indications

(1) MASTER ALERT light flashes and warning tone sounds

(2) FIRE warning light illuminates

b. Procedures - See NATOPS

**PROGRESS CHECK**

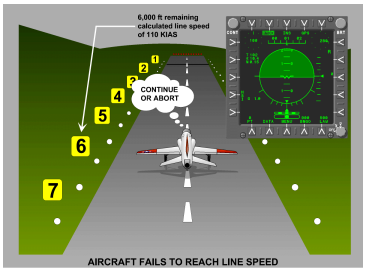
**Question 4 -- 1.5.3.1.5.1.2**
**What should you do with a fire warning indicator illumination and secondary indications of engine fire during takeoff with sufficient runway left to stop?**

ANSWER: Abort

**Question 5 — 1.5.3.1.5.1.2**
**What emergency procedure should you initiate with a confirmed engine fire during takeoff and insufficient runway remains to abort?**

ANSWER: Eject

***Sg 3, fr 6***
*Aircraft Fails to Reach Line Speed*




3. Aircraft fails to reach line speed **1.5.3.1.5.2.2**

NOTE: Reduced thrust on takeoff may be caused by bleed valve failure, compressor damage, intake icing, high density altitude, ECA malfunction, or other malfunctions. Use the performance charts to determine if runway length or density altitude limits safe operations. High density altitude reduces thrust

considerably and may be misinterpreted as a reduced-thrust situation caused by engine malfunction. Snow, slush, or standing water will greatly reduce aircraft acceleration and may be confused with reduced thrust on takeoff.

a. Indications

(1) RPM, EGT, or fuel flow below normal

(2) Slower than normal aircraft acceleration

b. Procedures

(1) If acceleration obviously less than normal

(a) Check throttle fully forward

(b) Check speed brakes retracted

(2) If line speed check not met

(a) ABORT (Execute abort procedure)

4. Engine overspeed **1.8.1.1.7.2**

a. Indications

(1) $N_1$

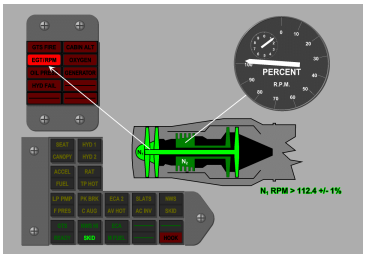
(a) MASTER ALERT light flashes and warning tone sounds

(b) EGT/RPM warning light illuminates when $N_1$ RPM > 112.4 $\pm$ 1% or EGT > 650 $\pm$ 8°C)

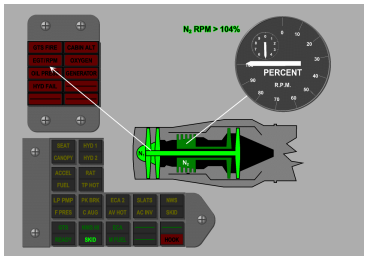
(2) $N_2$ RPM gauge indicates greater than 104%

b. Procedures - See NATOPS

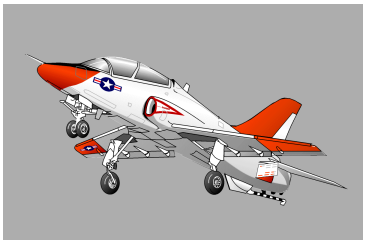
***Sg 3, fr 7***
*Engine Overspeed*




***Sg 3, fr 8***
*Engine Overspeed*



***Sg 3, fr 9***
*Blown Tire Damage Areas, Nose Gear (4 Overlays)*



***Overlay 1***

***Overlay 2***

***Overlay 3***

***Overlay 4***

5. Blown tire during takeoff **1.5.3.1.5.3.1.1, 1.5.3.1.5.3.2**

   a. Indications

      (1) Aircraft may suddenly veer left or right

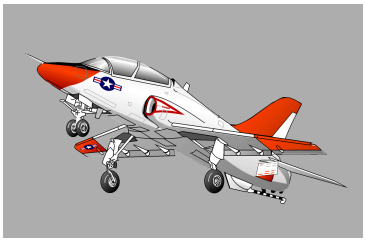
      NOTE: If a main gear tire blows, the aircraft will veer toward the blown tire.

      (2) Loud or muffled noise caused by initial tire destruction

      (3) Continuous rumble or vibration caused by flat tire

   b. Procedures - See NATOPS

***Sg 3, fr 13***
*Blown Tire Damage Areas, Main Gear (3 Overlays)*



***Overlay 1***

***Overlay 2***

***Overlay 3***

**LESSON NOTES**

*These graphics show areas which could be damaged by a blown tire. Explain how this damage will affect the aircraft and flight safety.*

*A blown nose wheel tire may cause engine FOD. A blown main gear tire may damage the flaps, and/or brake lines. Any blown tire may damage the gear doors or wheelwell equipment. If the decision to stop is made, the primary danger is loss of directional control. Do not attempt to taxi*

***CAUTION: Retraction of gear or flaps may cause additional damage to flaps, gear doors, or wheel well area.***

NOTE: Do not taxi with a flat or damaged tire.

**?** **Which CWS indicators will activate when a nose wheel steering failure occurs?**

ANSWER:
1. MASTER ALERT light flashes and caution tone sounds
2. NWS caution light illuminates

B. Engine failure after takeoff **1.5.3.1.5.4.2**

**LESSON NOTES**

*Emphasize to your students that there are many varieties of engine failures/flameouts; the indicators shown are for flameout.*

1. Indications
    a. Decreasing engine rpm and EGT
    b. Sudden loss of acceleration
    c. Unusual noise or vibration
2. Procedures
    a. Shore-based takeoff - See NATOPS
    b. Carrier-Based (catapult launch)
        (1) Procedures - See NATOPS

C. Aircraft settling off catapult **9.8.1.15.2**

1. Indications

a. AOA increasing above 24 units; airspeed below minimum catapult endspeed

b. Radio communication from tower

c. Altimeter readout and vertical velocity indicate descent

d. Pilot's sense of settling/deceleration

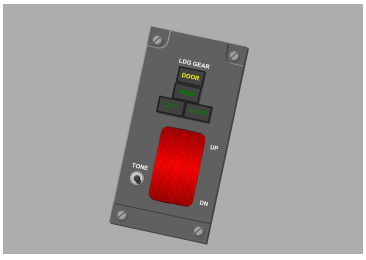
2. Procedures - See NATOPS

D. Landing gear/gear doors unsafe **1.5.4.3.1.1, 1.5.4.3.2**

**LESSON NOTES**

*Refer to cockpit indicators and controls to have students recall the indications of an unsafe gear or gear door.*

***Sg 3, fr 17***
*Unsafe Gear After Retraction*




1. Indications

a. Landing gear handle light remains illuminated

b. Normal sounds and feel of gear retraction not present

c. Wind noise/drag from landing gear/gear doors may be apparent, and yaw may occur with one main down

d. One or more landing gear lights (NOSE, LEFT, RIGHT) remain illuminated

NOTE: The NOSE, LEFT, and RIGHT light illuminate for down and locked, but are off if not down and locked.

e. Landing gear DOOR light remains illuminated

f. HYD 1 pressure gauge may indicate pressure loss

2. Procedures - See NATOPS

NOTE: Landing gear extension requires about 15 seconds and retraction about 10 seconds.

**PROGRESS CHECK**

**Question 6 — 1.5.3.1.5.3.2**
**Prior to becoming airborne you have indications of a blown tire. If you continue the takeoff, how should you position your landing gear and flaps?**

ANSWER: The flaps and landing gear should not be repositioned.

**Question 7 — 1.5.3.1.5.4.2**
**What are the emergency procedures for an engine failure during CAT launch?**

ANSWER:
1. Eject
2. If unable to eject - DITCH STRAIGHT AHEAD

*Sg 10, fr 2*
*Review Menu*

## SUMMARY

This lesson has presented procedures for emergencies occurring during the following phases of flight:

* Start
* Ground
* Takeoff

## CONCLUSION

It's critical that you come out of this lesson with the ability to recognize ground-based system malfunctions and to make safe and logical decisions about how to deal with them. You'll have many opportunities in the simulator to practice coping with the emergencies discussed in this lesson. You can't practice them too much. The safe completion of some future mission may depend on your ability to evaluate a malfunction correctly and act accordingly.

Your next event is a workbook lesson pertaining to the material that was just covered. This workbook is similar to the other workbooks that you will complete in this stage; however, the others precede the lecture and are intended to provide you with practice in locating material in the NATOPS which will prepare you for the lectures.

# LESSON GUIDE

**COURSE/STAGE:** TS, ADV & IUT / Emergency Flight Procedures

**LESSON TITLE:** Start, Ground, and Takeoff Emergency Procedures

**LESSON IDENTIFIER:** T-45C TS, ADV & IUT EMFP-02

**LEARNING ENVIRONMENT:** CAI

**ALLOTTED LESSON TIME:** 1.5 hr

**STUDY RESOURCES:**

* T-45C NATOPS Flight Manual, A1-T45C-NFM-000
* T-45C NATOPS Pilot's Pocket Checklist, A1-T45C-NFM-500

**(9-98) ORIGINAL**

**LESSON PREPARTION:**

Read

* Chapter 12, “General Emergencies”, Part V, Chapter 13, “Ground Emergencies”, and Chapter 14, Takeoff Emergencies , “T-45C NATOPS Flight Manual, A1-T45C-NFM-000, and the associated procedures in “Emergency Procedures” in the Pilot’s Pocket Checklist, A1-T45C-NFM-500

Review

* Lesson Guide, ENG-05, “Engine System and Related Systems Malfunctions”
* Lesson Guide, ENG-06, “Engine System Malfunctions”
* Lesson Guide, ENG-12, “Hydraulic Subsystem Malfunctions”
* Lesson Guide, ENG-22, “CNI System Malfunctions”
* Lesson Guide, CO-02, “Engine Start & Poststart”

**REINFORCEMENT: N/A**

**LESSON EXAMINATION:**

The objectives in this lesson will be tested in EMFP-06X.

## LESSON OBJECTIVES

**1.4.2.7.2**
Recall Procedures for Hot Start

**1.4.2.5.1**
Identify Indication of Hung Start

**1.4.2.5.2**
Recall Procedures for Hung Start

**1.4.2.2.2**
Recall Procedures for GTS Fire

**1.4.2.1.2**
Recall Procedures for Engine Fire/Tailpipe HOT on Start

**1.5.1.4.1.2**
Recall Procedures for Engine Fire/Tailpipe HOT on Deck

**1.5.1.4.2.2**
Recall the Procedures for Nose Wheel Steering Failure

**1.5.1.4.3.2**
Recall Procedures for Wheel Brake Failure

**1.8.1.1.4.2**
Recall Procedures for Engine Overtemp

**1.5.3.1.5.5.1.1**
Recall Situations Requiring Aborted Takeoff

**1.5.3.1.5.5.2**
Recall Procedures for Aborted Takeoff

**1.5.3.1.5.1.2**
Recall Procedures for Engine Fire During Takeoff

**1.5.3.1.5.4.2**
Recall the Procedures for Engine Failure on Takeoff

**1.10.5.1.1**
Identify Plane Captain Signals for Hot Brakes

**1.10.5.1.2**
Recall Indications of Unsafe Gear on Retraction

**1.5.4.3.1.1**
Recall Indications of Unsafe Gear on Retraction

**1.5.4.3.2**
Recall Procedures for Unsafe Gear on Retraction

## MOTIVATION

Use these exercises to solidify what you learned in EMFP-01. If there is something that still doesn't make sense, now is the time to get it straightened out.

## OVERVIEW

This lesson provides NATOPS exercises for emergency procedures occurring during the following phases of flight:

* Start
* Ground
* Takeoff

This lesson is presented in three basic phases:

Instruction Phase

The student will be guided "hands-on" through the emergency procedure with audio and on-screen text prompts. Completion of the instruction for the procedure qualifies the student to select that specific procedure from the Practice menu.

Practice Phase

The student may select any of the emergency procedures for which he/she has completed the instruction phase of training. The Practice session will identify the procedure being practiced in the header at the top of the screen, but will not tell the student which step to perform or how to perform it. Practice sessions demand the proper action in the proper sequence. Feedback is given and the opportunity to attempt the procedure again if an error is made. If desired, the student may retake an instructional section.

Random Practice

Once all the Practice Phase elements have been successfully completed, the student may elect to have the computer select emergency situations at random for practice.

There are three major differences between the Practice Phase and the Random Practice Phase.

1. In the Practice Phase, the emergency procedure is identified in the header at the top of the screen. In Random Practice the emergency is not identified.

2. At the completion of the Random Practice or when a step is incorrect, the lesson will ask you to identify which emergency procedure you are attempting.

3. Random Practice is not a lesson completion requirement. It is an opportunity for you to test yourself at a higher level. It is also an excellent means to review for a check flight when the simulator is not available.

**REFRESHER**

Recall start, ground, and takeoff emergency procedures you learned during EMFP-01

## PRESENTATION

I. Conventions unique to EMFP Lessons

A. Pop-up views

1. Subject controls/switches are magnified to enable more precise identification and selection.

2. Original area and the magnified area are outlined in orange.

3. The magnified view only contains active touch areas for the depicted controls and switches (if the ANTI-SKID switch appears in the magnified pop-up, only the magnified depiction may be selected... the unmagnified ANTI-SKID switch is inactive).

4. There may be unmagnified controls or switches outside the orange outlined areas that could also be active touch areas (brake pedals, tailhook, parking brake handle... etc.). In a practice or Random Practice session selections outside the pop-up area may be necessary to complete the procedure.

B. Throttle position icons

1. These are the power setting boxes located on the big blue arrow that appears when it is necessary to adjust the throttle position. To change the throttle setting, click on these boxes. Clicking on the throttle and attempting to drag it will not work.

C. How the Mandarin authoring system coordinates audio and motion with mouse or keyboard inputs.

1. Once an audio file begins, control of the cursor with the mouse is lost until the audio file is completed.

2. Similarly, all keyboard and mouse inputs are ignored during audio file play.

3. Motion files - those files that create movement such as indicator change/movement - have the same effect. Mouse or keyboard inputs will be ignored until the motion is complete.

4. Comprehending this coordination and exercising patience during the simulations can preclude considerable frustration.

II. CWS Button

A. Availability

1. Available during all Instructional and Practice segments

2. Unavailable during Random Practice segments

B. Activation

1. Select the CWS button to activate the instrument panel locator screen.

2. Select the item to be identified with the mouse. The official nomenclature, function and associated limits will appear at the top of the screen.

3. Multiple selections are available.

C. Return to lesson

1. Erase the current description at the top of the screen by selecting “MORE” from the control panel or place the cursor on the description text and click the mouse.

2. Select the CWS button from the control panel after the definition has been erased.

III. HOT Start **1.4.2.7.2**

A. Indications

1. EGT exceeds 550°C (overshoot of 20°C for 10 seconds)

B. Procedures - Refer to Part V, Chapter 13, Ground Emergencies, of the T-45C NATOPS

IV. HUNG Start **1.4.2.5.1/1.4.2.5.2**

A. Indications

1. RPM Stabilizes below 52%

2. EGT continues to rise towards starting limit of 550°C

B. Procedures - Refer to Part V, Chapter 13, Ground Emergencies, of the T-45C NATOPS

V. GTS Fire **1.4.2.2.2**

A. Indications

1. Outside the aircraft - the plane captain points behind the canopy at the GTS and gives the Lazy 8 signal.

2. Inside the aircraft

a. MASTER ALERT flashes

b. Warning tone sounds

c. GTS FIRE Warning light illuminates

B. Procedures - Refer to Part V, Chapter 12, General Emergencies, of the T-45C NATOPS

VI. Engine Fire **1.4.2.1.2**

A. Indications

1. Outside the aircraft - the plane captain gives the FIRE signal

2. Inside the aircraft

a. MASTER ALERT flashes

b. Warning tone sounds

c. FIRE warning light illuminates

3. Secondary indications

a. OIL PRESS warning light

b. EGT/RPM warning light

c. HYD 1 caution light

d. HYD 2 caution light

B. Procedures - Refer to Part V, Chapter 12, General Emergencies, of the T-45C NATOPS

VII. Tailpipe HOT on Start and on Deck **1.5.1.4.1.2**

A. Indications

1. Outside the aircraft - the plane captain gives the FIRE signal

2. Inside the aircraft

a. MASTER ALERT flashes

b. Caution tone sounds

c. TP HOT caution light illuminates

3. Secondary indications

a. OIL PRESS warning

b. EGT/RPM warning light

c. HYD 1 caution light

d. HYD 2 caution light

Note: In most cases a tailpipe fire will not illuminate either the TP HOT caution light or the engine FIRE light.

B. Procedures - Refer to Part V, Chapter 12, General Emergencies, of the T-45C NATOPS

VIII. Nose Wheel Steering Failure **1.5.1.4.2.2**

A. Indications

1. Aircraft doesn't respond to rudder steering commands or

2. MASTER ALERT flashes

3. Caution tone sounds

4. NWS caution light illuminates

B. Procedures - Refer to Part V, Chapter 12, General Emergencies, of the T-45C NATOPS

IX. Wheel Brake Failure **1.5.1.4.3.2**

A. Indications

1. Aircraft doesn't slow down when brakes are applied

2. Other possible indications SKID or HYD 1 caution light and brake accumulator low

B. Procedures - Refer to Part V, Chapter 13, Ground Emergencies, of the T-45C NATOPS

X. Engine Overtemp - **1.8.1.1.4.2**

A. Indications:

1. MASTER ALERT flashes

2. Warning tone sounds

3. EGT/RPM warning light illuminates

4. These indications are most likely to occur during engine acceleration for takeoff when EGT exceeds 645° C or $N_1$ RPM exceeds 108%

B. Procedures - Refer to Chapter 4, Operating Limitations and Chapter 12, General Emergencies, of the T-45C NATOPS

XI. Aborted Takeoff **1.5.3.1.5.5.1.1, 1.5.3.1.5.5.2**

A. Indications

1. Unacceptable engine acceleration

2. Less than normal takeoff EGT/RPM

3. Illumination of the FIRE warning light

4. Trim failure

5. Loss of oil pressure

6. Fuel transfer failure

7. Smoke in the cockpit

8. Abnormally slow aircraft acceleration to takeoff speed

9. Blown tire

10. Uncommanded swerving

11. Loss of canopy

B. Procedures - Refer to Chapter 14, Takeoff Emergencies, of the T-45C NATOPS

XII. FIRE during takeoff **1.5.3.1.5.1.2**

A. Indications

1. FIRE warning light illuminates

2. MASTER ALERT flashes

3. Warning tone sounds

4. Secondary indications may be EGT/RPM, and /or OIL PRESS warning light, HYD 1, HYD 2, TP HOT caution lights, abnormal fuel flow, erratic or rough engine operation, and visible signs of smoke.

B. Procedures - refer to Chapter 12, General Emergencies, of the T-45C NATOPS

XIII. Engine Failure on Takeoff **1.5.3.1.5.4.2**

A. Indications

1. Decreasing engine rpm and EGT

2. Sudden loss of acceleration

3. Unusual noise or vibration

B. Procedures - refer to Chapter 12, General Emergencies, of the T-45C NATOPS

XIV. Hot Brakes **1.10.5.1.1, 1.10.5.1.2**

A. Indications

1. Outside observer reports brakes are smoking

2. Plane captain gives the hot brake signal

B. Procedures - refer to Chapter 13, Ground Emergencies, of the T-45C NATOPS

XV. Unsafe Gear on Retraction **1.5.4.3.1.1, 1.5.4.3.2**

A. Indications

1. Landing gear handle light remains on

2. Normal sounds and feel of gear retraction not present

3. One or more landing gear lights (NOSE, RIGHT, LEFT) remain illuminated

B. Procedure - Refer to Chapter 14, Takeoff Emergencies, of the T-45C NATOPS

## SUMMARY

This lesson has provided NATOPS exercises for emergency procedures occurring during the following phases of flight:

* Start
* Ground
* Takeoff

## CONCLUSION

You should finish this lesson with the ability to recognize system malfunctions and to make safe and logical decisions about how to deal with them. You'll have many opportunities in the simulator to practice coping with the emergencies discussed in this lesson. You can't practice them too much. The safe completion of some future mission may depend on your ability to correctly evaluate a malfunction and act accordingly.

# LECTURE GUIDE

**COURSE/STAGE:** TS, ADV & IUT / Emergency Flight Procedures

**LESSON TITLE:** Operational and Ejection Emergency Procedures

**LESSON IDENTIFIER:** T-45C TS, ADV & IUT EMFP-03

**LEARNING ENVIRONMENT:** Classroom

**ALLOTTED LESSON TIME:** 1.0 hr

**STUDY RESOURCES:**

* T-45C NATOPS Flight Manual, A1-T45AC-NFM-000
* T-45C NATOPS Pilot's Pocket Checklist, A1-T45AC-NFM-500
* Lesson Guides for Engineering, "Canopy and Ejection Seat Systems Malfunctions," and Engineering, "CNI System Malfunctions"

**(9-98) ORIGINAL**

**LESSON PREPARATION:**

Complete:

* EMFP-03 homework lesson, “Operational and Ejection Emergency Procedures”

Read:

* T-45C NATOPS Flight Manual, A1-T45AC-NFM-000
  - Spin Characteristics in Chapter 11, “Flight Characteristics”
  - Emergency egress procedures in Chapter 13, “Ground Emergencies”
  - Departure/Spin, Uncommanded Roll/Yaw, and Controllability Check procedures in Chapter 15, “In-Flight Emergencies”
  - Ditching procedures in Chapter 16, “Landing Emergencies”
  - Chapter 17, “Ejection”
* Associated procedures in “Emergency Procedures” in the Pilot’s Pocket Checklist, A1-T45AC-NFM-500

Review:

* Lesson Guide, (Eng), “Canopy and Ejection Seat Systems Malfunctions”
* Lesson Guide, (Eng), “CNI System Malfunctions”

**REINFORCEMENT:** N/A

**EXAMINATION:**

The objectives in this lesson will be tested in EMFP 06X.

## LESSON OBJECTIVES

**1.10.5.4.1**
Identify situations requiring emergency egress

**1.5.1.4.5.2.1**
Recall procedures for emergency egress

**10.7.9.1.2**
Recall procedures for departure/spin recovery

**1.8.1.6.1.3**
Recall procedures for uncommanded roll/yaw

**1.8.1.10.6.2**
Recall procedures for controllability check (midair/bird strike/ structural failure)

**1.8.1.10.3.1.1**
Recall indications of ejection situations

**1.5.3.1.5.6.1**
Identify requirements to eject

**1.5.3.1.5.6.1.1**
Recall ejection criteria/envelopes

**1.5.3.1.5.6**
Recall procedures for low altitude ejection

**1.8.1.10.3.2**
Recall procedures for ejection

**1.8.1.10.5.2.1**
Recall survival procedures for over-water ejection situation

**1.8.1.10.12.1**
Recall communications for operational emergency situations

**1.8.1.10.4.1.1**
Recall indications of ditching situations

**1.8.1.10.4.2**
Recall procedures for ditching

**1.8.1.10.1.1**
Identify indications of lost aircraft situations

**1.8.1.10.1.2**
Recall procedures for lost aircraft situations

**1.8.1.10.5.1.1**
Recall duties of SAR on-scene commander

**1.8.1.10.5.1.2**
Recall procedures for performing as SAR on-scene commander

## MOTIVATION

The T-45C is an expensive training aid. It would be great if we could bring every sick or out of control Goshawk safely back home. Since this is not always possible, the Navy has developed an efficient egress system. Although the system is forgiving, it's not "foolproof." Once the ejection decision is made, you must know what to expect and how to contribute to an expeditious, successful ejection and rescue.

## OVERVIEW

The goals of this lesson are to sharpen your decision-making ability should you face a malfunction and to detail the procedures to follow once you have identified a malfunction.

This lesson presents procedures for the following emergency situations:

* Emergency egress
* Aircraft control emergencies
* Ejection
* Emergency comm
* Ditching
* SAR operations

## REFRESHER

Recall the emergency procedures for your last aircraft.

## PRESENTATION

NOTE: Procedural steps preceded by an asterisk (*) are considered immediate action items. You must be able to accomplish these steps without reference to the checklist.

*Sg 1, fr 2*
*Lesson Organization*

**OPERATIONAL AND EJECTION EMERGENCY PROCEDURES**

* Emergency egress
* Aircraft control emergencies
* Ejection situations, requirements, and criteria/envelopes
* Comm procedures for operational emergencies
* Ditching
* SAR operations

I. Emergency egress **1.10.5.4.1, 1.5.1.4.5.2.1**

**? Identify situations requiring emergency egress.**

ANSWER:
1. GTS fire during ground start
2. Engine fire
3. After structural damage resulting from brake failure, aborted takeoff, or crash landing
4. Failed ejection seat resulting in forced landing or ditching
5. Mishaps during carrier operations resulting in water impact

NOTE: Situations requiring emergency egress are generally a result of structural or mechanical damage occurring during start, taxi, takeoff, landing, forced landing, or ditching.

A. Situations

1. GTS fire during ground start

2. Engine fire

3. After structural damage resulting from brake failure, aborted takeoff, or crash landing

4. Failed ejection seat resulting in forced landing or ditching

5. Mishaps during carrier operations resulting in water impact

B. Procedures - See NATOPS

NOTE: At ground level, the ejection option exists as long as the seat and parachute harness remain fastened (occupants properly strapped in), the cockpit canopy remains closed and locked, and the aircraft is in a substantially upright attitude. Ejection must not be attempted unless each of these conditions are satisfied. It is stressed that following a crash landing where it is possible that damage to the canopy frame or front fuselage has occurred and where escape by ejection may be the best course, no attempt should be made to open the canopy. If such an attempt were made and resulted in the canopy jamming in a partially open position, the ejection option would be lost and manual egress from the cockpit might also be lost. Further, the occupants should not unstrap until it is evident that no danger is present which might inhibit manual escape from the aircraft.

**WARNING: Do not eject unless the canopy is fully closed.**

**PROGRESS CHECK**

**Question 1 — 1.5.1.4.5.2.1**
**What precautions should you take prior to pulling the MDC firing handle?**

ANSWER: Lower helmet visor, close eyes, and keep hands and body as far away as possible from the MDC pattern on the canopy.

*Sg 2, fr 2*
*Lesson Organization*

**OPERATIONAL AND EJECTION EMERGENCY PROCEDURES**

* Emergency egress
* Aircraft control emergencies
* Ejection situations, requirements, and criteria/envelopes
* Comm procedures for operational emergencies
* Ditching
* SAR operations

II. Aircraft control emergencies **10.7.9.1.2, 1.8.1.6.1.3, 1.8.1.10.6.2**

A. Departure/spin

1. Indications: The angle of attack indicator is used to determine if the aircraft is in an upright or inverted spin, while the turn needle will always point in the direction of the spin.

NOTE: If the engine flames out, the right MFD is lost and the left MFD reverts to the ADI display and will operate for 3 minutes.

a. Departure: Instrument indications and aircraft motion about all axes will vary depending on the maneuver performed when the aircraft departed, but instruments and aircraft motion will not have stabilized.

b. Spin

(1) Upright

(a) AOA: above 28 units (pegged)

(b) G: Positive

(c) Turn needle: pegged on direction of spin

(d) Airspeed oscillating between 80-140 knots

(2) Inverted

(a) AOA: 0 units (pegged)

(b) G: Negative

(c) Turn needle: pegged in direction of spin

(d) Airspeed oscillating between 50-160 knots

2. Procedures - See NATOPS

B. Uncommanded roll/yaw

1. Indications: If rolling and yawing occurs during operation of the wing flaps/slats or while the flaps/slats are extended, an asymmetric flaps condition probably exists

2. Procedures - See NATOPS

C. Controllability check

1. Indications: Aircraft damaged by midair collision, bird strike, canopy loss, overstress or hard landing

NOTE: The decision to eject or investigate the slow flight characteristics should be based on the extent of the damage, fuel state, flight conditions, field landing facilities available, other existing emergencies, and pilot experience.

2. Procedures - See NATOPS

***Sg 3, fr 2***
*Lesson Organization*

**OPERATIONAL AND EJECTION EMERGENCY PROCEDURES**

* Emergency egress
* Aircraft control emergencies
* Ejection situations, requirements, and criteria/ envelopes
* Comm procedures for operational emergencies
* Ditching
* SAR operations

III. Ejection situations, requirements, and criteria/envelopes **1.8.1.10.3.1.1, 1.5.3.1.5.6.1, 1.5.3.1.5.6.1.1**

A. Situations requiring possible ejection

1. Engine failure/settling after takeoff or cat launch
2. Confirmed airborne engine fire
3. Structural damage with resulting loss of control
4. Out-of-control flight below 10,000 ft AGL
5. Engine flameout at low altitude
6. Departing the runway at high speed
7. Engine flameout with no relight
8. Total hydraulic failure

B. Requirements for safe ejection

1. Canopy must be closed and locked
2. Seat must be armed and safety pins pulled
3. Command ejection selector must be set in proper position

NOTE: In addition to the preceding requirements, you should, if able, level the wings, reduce airspeed to 250 KIAS or less, and minimize sink rate (climb preferred).

C. Body positioning

1. *Press head firmly against headrest*
2. *Elevate chin slightly (10 degrees)*
3. *Press shoulders and back firmly against seat*

4. *Hold elbows and arms firmly against sides*

5. *Press buttocks firmly against seat back*

6. *Attempt to place thighs flat against seat*

7. *Place heels firmly on deck, toes on rudder pedals*

D. Ejection criteria/envelopes

1. *You must use the ejection seat to escape from the aircraft in flight. If the canopy fails to detonate, the seat will eject through the canopy. Analysis of ejections using Navy common aircrew ejection seat (NACES) show:*

   a. *Optimum airspeed for ejection is 250 knots or less.*

   b. *Appreciable forces are exerted on the body when ejection is performed at airspeeds of 250 to 600 knots rendering escape more hazardous.*

   c. *Above 600 knots, excessive forces are exerted on the body making ejection extremely hazardous.*

2. *When circumstances permit, slow the aircraft prior to ejection to reduce the forces on your body.*

3. *With wings level and no sink rate, ejection is feasible within the following parameters*

   a. *Ground level, zero airspeed*

   b. *Ground to 60,000 ft, 600 kts maximum*

4. *Ejection at low altitude allows a matter of seconds to prepare for landing. Over water, inflation of the LPU is the most important step to be accomplished. The second most important step is the release of the parachute quick-release fittings after entering the water if the SEAWARS Koch fittings fail to operate.*

5. *The ejection system is designed to go through the canopy whether or not the canopy is prefractured. Ejection with the canopy in any position other than fully closed and locked will involve contact of the ejection seat and/or occupant with the canopy frame resulting in seat malfunction and serious occupant injury. If the canopy opens inadvertently in flight and a controlled ejection is required, yaw the aircraft to starboard to cause the canopy to depart the aircraft.*

6. Minimum ejection altitude charts

   a. Purpose: to identify operating envelope of the NACES ejection seat

   b. Using the charts

      NOTE: Minimum safe escape conditions are those resulting in full inflation of the parachute prior to ground contact.

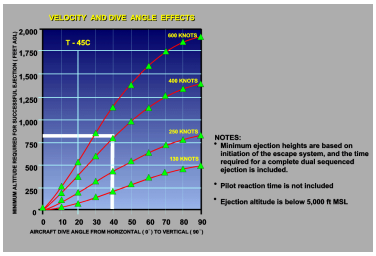
      (1) Determine which chart to use

          NOTE: The following example uses Figure 17-2 (1 of 3), "Minimum Safe Ejection Altitudes: Aircraft Dive Angle from Horizontal (0°) to Vertical (90°)," in the NATOPS. The procedure is similar for the other charts.

      (2) Determine where dive angle (vertical line) intercepts speed curve (i.e., 40° and 400 knots)

      (3) From this intersection, move left to determine minimum AGL altitude to <u>initiate</u> ejection (approx 800 ft)

***Sg 3, fr 3***
*Minimum Safe Ejection Altitudes*



**LESSON NOTES**

*Further demonstrate the plotting process on the charts, using random examples of airspeed and dive angle.*

E. Ejection procedures **1.5.3.1.5.6, 1.8.1.10.3.2, 1.8.1.10.5.2.1**

1. Considerations

a. Communicate intentions to other cockpit, wingman, and ATC, if practicable

b. Ejection decision, in most cases, rests with pilot-in-command and should be made before sink rate and altitude conditions jeopardize safe ejection for both pilots

c. If aircraft is controllable, head toward an area of minimum population

d. Ejection seat must be used to escape aircraft in flight and canopy must be either closed and locked or missing. If canopy fails to detonate, seat will impact and shatter the canopy and continue up the catapult rail.

***WARNING: Ejection with the canopy in any position other than fully closed and locked is not recommended. Serious bodily injury and seat malfunction may occur.***

***WARNING: Never actuate the emergency restraint release before ejection. Actuation of the handle releases the pilot from the seat and moves the SAFE/ARMED handle to the SAFE position, making ejection initiation by the seat occupant impossible. Further, if ejection is then initiated by the other cockpit, both seats will be ejected with probable fatal results.***

e. Low altitude ejection (below 18,000 ft)

(1) Successful low altitude ejection depends primarily on the following being within limits

(a) Dive angle

(b) Sink rate

(c) Angle of bank

(d) Airspeed

(e) Altitude

(2) Ejection on takeoff or in landing pattern

(a) Keep right hand on stick to maintain proper attitude

(b) Pull ejection handle while maintaining proper body position

(3) Convert any excess airspeed to a climb to slow aircraft and improve ejection seat trajectory

NOTE: The additional altitude increases the time available for seat separation and parachute deployment.

(4) If aircraft is descending out of control, eject by 10,000 ft AGL. If the aircraft is descending under control, do not delay ejection below 2,000 ft AGL.

**WARNING: Do not delay ejection if the aircraft is nosedown and cannot be leveled.**

f. High altitude ejection (above 18,000 ft)

(1) As in low altitude ejection, climb to slow aircraft to safer speed, improve ejection seat trajectory, and provide more altitude, if desirable

NOTE: If aircraft is controllable and not on fire (i.e., after engine fire with engine shut down and fire out), consider descending to a lower altitude prior to ejection.

(2) After high altitude ejection, seat and pilot free-fall to 18,000 ft, at which time seat/man separation occurs and parachute deploys

NOTE: Manual seat/man separation may be accomplished by pulling the emergency restraint release handle on the right side of the seat bucket.

g. Over-water ejection

(1) Inflate LPU, and snap lobes together, primary mode of LPU inflation - manual (beaded handle), automatic mode (only a backup)

**WARNING: Failure to snap waist lobes before water entry may result in face-down flotation.**

(2) Deploy the raft by pulling either right or left release prior to entering the water

(3) Upon water impact, manual release of parachute Koch fittings is recommended, even though they should release automatically (SEAWARS)

(4) When ejecting in immediate vicinity of carrier, parachute entanglement combined with wake can submerge you. The deployed seat survival kit may contribute to shroud line entanglement.

2. Procedures - See NATOPS

**LESSON NOTES**

*Direct your students to refer to Figure 17-1, "Ejection Procedures," in Part V of the NATOPS while covering the following ejection procedures.*

a. Post-ejection (after parachute deployment)

(1) Inflate LPU

(2) Seat kit deployment during descent

***WARNING: Deploying the seat kit/raft is not recommended over land.***

(3) Parachute steering

(4) Parachute landing fall (PLF)

(5) Rescue

(6) Using the rescue strop (horse collar)

(7) Using the forest penetrator

**PROGRESS CHECK**

**Question 2 — 1.5.3.1.5.6.1**
**How must the canopy be configured to initiate a safe ejection?**

ANSWER: Either closed and locked or missing

IV. Communication procedures for operational emergency situations **1.8.1.10.12.1**

*Sg 4, fr 2*
*Lesson Organization*

**OPERATIONAL AND EJECTION EMERGENCY PROCEDURES**
* Emergency egress
* Aircraft control emergencies
* Ejection situations, requirements, and criteria/envelopes
* Comm procedures for operational emergencies
* Ditching
* SAR operations

A. Aircraft with emergency (as appropriate)

1. If necessary and possible, climb for improved communications

2. Squawk Mode 3/A, code 7700 (emergency)

3. Transmit distress call consisting of as many of the following elements as possible

a. "MAYDAY, MAYDAY, MAYDAY" (Distress)—serious or imminent danger requiring immediate assistance

b. "PAN PAN, PAN PAN, PAN PAN" (Urgency)—a condition concerning the safety of an aircraft or other vehicle not requiring immediate assistance

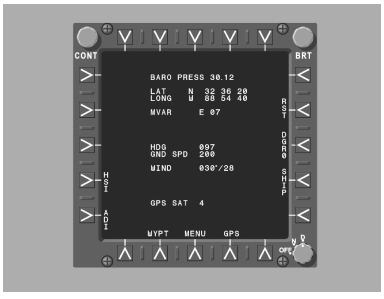
c. Name of station addressed

d. Aircraft identification and type

e. Present position (from a NAVAID, latitude, longitude, or landmark), altitude, and heading

NOTE: Present aircraft position is located on the aircraft data display page.

*Sg 4, fr 4*
*Aircraft Data Display*



f. Nature of problem

g. Your intentions and requests

h. Fuel remaining in hours and minutes

i. Number of crew on board

j. Any other useful information (weather, etc.)

4. If time permits, break emergency transmission after providing aircraft identification and type to allow reply

   NOTE: Breaking transmission allows positive radio contact to be verified before you transmit the remaining information.

5. After establishing radio contact, comply and cooperate

6. Do not change to another frequency or ground station unless absolutely necessary

7. If situation could result in crash landing, ditching, or ejection, take following actions to assist SAR units

   a. Repeat distress message, if required

   b. Add following to aid SAR

      (1) Visible landmarks

      (2) Aircraft color

      (3) Emergency equipment on board

8. If over water, request position of nearest commercial or Naval/Coast Guard vessel

   NOTE: The FAA facility, Coast Guard Rescue Center, or other aircraft may be able to supply this information.

9. After crash landing/ditching, remain near aircraft and prepare means of signaling/communicating with SAR aircraft

B. Wingman (aircraft without emergency)

1. Follow directions from flight leader or SAR commander

2. Assume duties of on-scene SAR commander, if necessary

**PROGRESS CHECK**

**Question 3 — 1.8.1.10.12.1**
**What should be transmitted during an emergency to identify that the situation is urgent?**

ANSWER: PAN PAN, PAN PAN, PAN PAN

V. Ditching **1.8.1.10.4.1.1, 1.8.1.10.4.2**

A. *Ditching the aircraft should be the pilot's last choice. Ejection is recommended whenever possible*

B. Procedures - See NATOPS

***Sg 6, fr 2***
*Lesson Organization*

**OPERATIONAL AND EJECTION EMERGENCY PROCEDURES**

* Emergency egress
* Aircraft control emergencies
* Ejection situations, requirements, and criteria/envelopes
* Comm procedures for operational emergencies
* Ditching
* SAR operations

**PROGRESS CHECK**

**Question 4 — 1.8.1.10.4.2**
**Describe the desired flight path you should attempt when ditching.**

ANSWER: Fly parallel to swell pattern and attempt to touch down along wave crest.

*Sg 7, fr 2*
*Lesson Organization*

**OPERATIONAL AND EJECTION EMERGENCY PROCEDURES**

* Emergency egress
* Aircraft control emergencies
* Ejection situations, requirements, and criteria/envelopes
* Comm procedures for operational emergencies
* Ditching
* SAR operations

# VI. SAR operations

## A. Lost aircraft situations **1.8.1.10.1.1, 1.8.1.10.1.2**

### 1. Indications

a. Disorientation

b. Unable to recognize geographic landmarks, cities, waterways, highways, etc.

c. Unable to establish position using TACAN, VOR or Waypoints

d. Unable to establish position with ATC using IFF

*Sg 7, fr 3*
*The Five Cs*

**(1) CONFESS**
**(2) CLIMB**
**(3) CONSERVE**
**(4) COMMUNICATE**
**(5) CONFORM**

**THE FIVE Cs**

### 2. Procedures

a. Perform the five Cs

(1) Confess (state your emergency)

(2) Climb

(3) Conserve (max endurance until oriented, then max range)

(4) Communicate (Guard or best frequency, and IFF Mode 3/A, code 7700)

(5) Conform

b. Perform local area/ship procedures

(1) Admit you are lost

(2) Climb to optimum altitude for fuel/ communications

(3) Climb toward coastline

(4) While climbing, attempt TACAN, VOR or Waypoint orientation

(5) On level off, reduce to $V_{me}$ (velocity for maximum endurance)

B. SAR on-scene commander **1.8.1.10.5.1.1, 1.8.1.10.5.1.2**

NOTE: SNPs should maintain a minimum of 2,500 ft MSL and 250 KIAS.

1. *In the event an aircraft mishap occurs beyond the control boundaries of an airport, the responsibility for initial coordination of the search and rescue effort is left with one of the following*

   a. *Senior aviator in flight*

   b. *Senior student in flight*

   c. *Any aviator airborne identifying himself/herself as senior*

2. *The on-scene commander shall*

   a. *Assume responsibility for remainder of flight*

   b. *Make the necessary voice reports*

   c. *Keep the downed aircraft/pilots in sight*

3. *Flight management by on-scene commander falls into two categories*

   a. *Remainder of flight remains intact*

   b. *Flight members not needed for SAR effort are ordered to return to base*

      *NOTE: The particulars of either situation listed above should be covered in the flight brief and be fully understood by all members in the flight.*

4. *The on-scene commander should utilize the following checklist commensurate with the situation*

   a. *Identification*

      (1) *Number of survivors*

      (2) *Establish an order of communication*

      (3) *Determine injuries*

      (4) *Check all assets' time on station, and equipment on board which may help pinpoint survivor location, etc.*

         *(a) Set BINGO fuel for nearest suitable airfield*

         *(b) Note latitude and airfield longitude on aircraft data display when crash site or survivor(s) are located*

   b. *Location*

      (1) *Request general terrain description*

      (2) *Determine signaling devices*

      (3) *Request beeper for homing*

      (4) *Request survivor(s) give vectors to position*

      (5) *Pinpoint location of each survivor*

   c. *Recovery*

      (1) *Brief helo and remainder of SAR team*

      (2) *Number and physical condition of survivor(s)*

      (3) *Distance to survivor(s) from a known geographical checkpoint*

(4) *Terrain description*

(5) *Survivor(s) pinpoint location*

(6) *Altitude of recovery area*

(7) *Wind speed and direction - on HSI display*

(8) *Describe survivor(s) signal devices*

(9) *Describe ingress/egress routes*

(10) *Emergency safe landing areas*

d. *Direct survivor(s) to*

(1) *Prepare and ignite smokes*

(2) *Vector helo if necessary*

(3) *Retain helmet for recovery*

**PROGRESS CHECK**

**Question 5 — 1.8.1.10.1.2**
**What are the five Cs?**

ANSWER:
1. Confess (state your emergency)
2. Climb
3. Conserve (max endurance until oriented, then max range)
4. Communicate (Guard or best frequency, and IFF Mode 3/A, code 7700)
5. Conform (follow local rules, flight brief, FARs)

*Sg 10, fr 2*
*Review Menu*

## SUMMARY

This lesson has presented procedures for the following emergency situations:

* Emergency egress
* Aircraft control emergencies
* Ejection
* Emergency comm
* Ditching
* SAR operations

## CONCLUSION

Unlike most of the other emergencies you'll study in this block, which can safely be simulated in the IFT, situations that end in ejection, ditching, or emergency egress are difficult to simulate. The first time a student ejects from an aircraft will be for real. There are no practice ditching flights. When the time comes, they'll have to know the ejection envelope without reference to the charts in the NATOPS, and they'll have to remember not to release the lower Koch fittings if they're planning on using the survival raft. As on-scene commander use all T-45C assets available, aircraft present position latitude and logitude, BINGO setting and waypoint data to aid you in managing the rescue effort.

# HOMEWORK LESSON

**COURSE/STAGE:** TS, ADV & IUT / Emergency Flight Procedures

**LESSON TITLE:** Operational and Ejection Emergency Procedures

**LESSON IDENTIFIER:** T-45C TS, ADV & IUT EMFP-03

**STUDY RESOURCES:**

* T-45C NATOPS Flight Manual, A1-T45AC-NFM-000
* T-45C NATOPS Pilot's Pocket Checklist, A1-T45AC-NFM-500
* Lesson Guides for Engineering, "Canopy and Ejection Seat Systems Malfunctions," and Engineering, "CNI System Malfunctions"

**LESSON PREPARATION:**

Read:

* T-45C NATOPS Flight Manual, A1-T45AC-NFM-000
  - Emergency egress procedures in Chapter 13, "Ground Emergencies"
  - Departure/Spin, Uncommanded Roll/Yaw, and Controllability Check procedures in Chapter 15, "In-Flight Emergencies"
  - Ditching procedures in Chapter 16, "Landing Emergencies"
  - Chapter 17, "Ejection"
* Associated procedures in "Emergency Procedures" in the Pilot's Pocket Checklist, A1-T45AC-NFM-500

Review:

* Lesson Guide, (Eng), "Canopy and Ejection Seat Systems Malfunctions"
* Lesson Guide, (Eng), "CNI System Malfunctions"

**(9-98) ORIGINAL**

**REINFORCEMENT:** N/A

**EXAMINATION:** N/A

## MOTIVATION

This workbook is concerned with what to do when emergency procedures don't work. We don't dwell on it, but it's a fact that sometimes you can't recover an aircraft in trouble. This workbook covers operational and ejection emergency procedures. Here's why you should learn them: they will save your life.

## OVERVIEW

The goals of this lesson are to familiarize you with the operational and ejection emergency procedures in the NATOPS and to prepare you for the lecture in EMFP-04.

This lesson provides NATOPS research exercises for the following emergency situations/procedures:

* Ejection
* Ditching and emergency egress
* Aircraft control emergencies
* SAR operations

## REFRESHER

Recall ejection emergency procedures you learned during training on previous aircraft.

## PRESENTATION

NOTE: The emergency procedures required by the following Practice Exercises are derived entirely from Part V of the T-45C NATOPS.

NOTE: Procedural steps preceded by an asterisk (*) are considered immediate action items. You should be able to accomplish these steps without reference to the checklist.

### EJECTION SITUATIONS, REQUIREMENTS, CRITERIA/ENVELOPES, AND PROCEDURES

One important thing to remember when preparing for ejection is body positioning. Failure to be in the proper position can result in injury due to high g forces.

### PRACTICE EXERCISE 1

**What are seven steps to remember when positioning your body for ejection?**

**1.** _____
**2.** _____
**3.** _____
**4.** _____
**5.** _____
**6.** _____
**7.** _____

### PRACTICE EXERCISE 2

**The most important thing to remember if attempting a low altitude ejection is to stop the_____ _____ prior to initiating ejection. Ejection seat trajectory is further improved if you _____ the aircraft prior to ejection.**

### PRACTICE EXERCISE 3

**Even though the LPU is designed to inflate automatically upon contact with water, manual inflation is the primary mode of operation. After parachute deployment over water, locate and pull the LPU _____ _____ down and straight out. If this fails to inflate the LPU, use the _____ _____ tube. If necessary, squeeze the LPU waist lobes together to help release the collar lobe or manually release the Velcro on the _____ _____. Failure to _____ the waist lobes before water entry may result in face-down flotation.**

**PRACTICE EXERCISE 4**

**After you've inflated the LPU during an over-water ejection, your next step is to deploy the _____ _____. To do this, locate the _____ _____ at the rear of the seat kit and pull until deployed. When full deployment occurs, the _____ _____ will be suspended below the upper half of the seat kit.**

**PRACTICE EXERCISE 5**

**When preparing to make a parachute landing over water, maneuver so that you are facing into the wind and then assume the proper body position for landing:**

**feet** _____
**knees** _____
**toes** _____
**eyes** _____
**canopy release fittings** _____
**elbows** _____

**PRACTICE EXERCISE 6**

**When preparing to make a parachute landing over land, maneuver so that you are facing into the wind and then assume the proper body position for landing. In addition, complete the following:**

**visor** _____
**gloves** _____
**seat kit** _____

**PRACTICE EXERCISE 7**

**What are the five points of body contact during a parachute landing on the ground?**

**1.** _____
**2.** _____
**3.** _____
**4.** _____
**5.** _____

**PRACTICE EXERCISE 8**

**When using the rescue hook, you must do the following things: attach the _____ hook to the gated helo-hoist lift ring. Then cross your arms in front of your chest and place your head _____ and to the _____. Give the thumbs up to the helo-hoist operator. When you clear the ground or water, _____ your feet.**

**PRACTICE EXERCISE 9**

**Using Figure 17-2, Minimum Safe Ejection Altitudes (sheet 1), in Part V of the NATOPS, compute the Minimum Safe Ejection Altitudes for forward seat ejections given the following airspeeds and dive angles:**

**250 KIAS and 10 deg _____ft AGL**
**285 KIAS and 30 deg _____ft AGL**
**400 KIAS and 90 deg _____ft AGL**
**475 KIAS and 60 deg _____ft AGL**
**600 KIAS and 30 deg _____ft AGL**

**PRACTICE EXERCISE 10**

**Using Figure 17-2, Minimum Safe Ejection Altitudes (sheet 2) in Part V of the NATOPS, compute the minimum safe ejection altitudes for forward seat ejections given the following sink rates and airspeeds:**

**10,000 fpm and 400 KIAS _____ft AGL**
**2,000 fpm and 250 KIAS _____ft AGL**
**6,000 fpm and 400 KIAS _____ft AGL**
**0 fpm and 130 KIAS _____ft AGL**
**8,000 fpm and 250 KIAS _____ft AGL**

**DITCHING AND EMERGENCY EGRESS**

Due to the inherent dangers of ditching, the aircraft should be ditched only when ejection has failed—it should be your last choice.

**PRACTICE EXERCISE 11**

**Before ditching, you should make your radio distress call, squawk _____ on IFF, jettison _____ _____, _____ the landing gear, and lower the flaps/slats _____ down.**

**PRACTICE EXERCISE 12**

**If you must ditch in the water, you should fly parallel to the _____ pattern and touch down along the wave _____.**

**PRACTICE EXERCISE 13**

**When the aircraft has stopped after ditching, you should pull the _____ _____ _____ and release the upper Koch fittings. The lower Koch fittings must be released if you intend to leave the survival kit in the aircraft.**

## AIRCRAFT CONTROL EMERGENCIES

### PRACTICE EXERCISE 14

**If you depart the aircraft from controlled flight you will perform these steps: *_____ controls, *_____ the speed brakes, throttle smoothly to *_____. Then monitor AOA, turn needle, airspeed, and altitude. If an upright spin is confirmed, apply rudder *_____turn needle, lateral stick *_____ turn needle (spin direction), and longitudinal stick *_____. If recovery indicated or airspeed increasing through 160 kts, lateral stick - *_____. When recovery indicated, rudder - SLOWLY RELEASE PEDAL FORCE. If aircraft is out of control passing 10,000 ft AGL, EJECT.**

### PRACTICE EXERCISE 15

**While on approach you have a midair collision with a large bird. You see damage to the port slat, but have no WCP indications. You are VFR with adequate fuel and near home base. Based on your experience, you should perform a _____ _____.**

1. **Climb as required, maintaining _____ _____ and proceed toward point of intended landing.**
2. **When possible, obtain a _____ _____ by another aircraft to assist in evaluating the damage.**
3. **Slow the aircraft to _____ knots in _____ knot increments.**
4. **Landing gear - _____**
5. **Slow the aircraft in _____ knot increments; slow to an airspeed at which controllability starts to become marginal (no slower than _____ _____). Increase airspeed _____ knots and use as a minimum airspeed for the duration of the flight.**
6. **Since you have damage to the slat area but no damage in the flap area, you should consider a _____ _____, _____ _____, or a _____ _____ landing. Flap extension is at your discretion if minimum airspeed is too high for landing.**
7. **Field arrested landing recommended. Shipboard landing _____ _____.**

## SAR OPERATIONS

### PRACTICE EXERCISE 16

**In the event that an aircraft mishap occurs beyond the control boundaries of an airport, you must know the hierarchy of responsibility for initial coordination of the search and rescue effort. Who are these individuals in order of seniority?**

1. _____
2. _____
3. _____

## SUMMARY

This lesson has provided NATOPS research exercises for the following emergency situations/procedures:

* Ejection
* Ditching and emergency egress
* Aircraft control emergencies
* SAR operations

## CONCLUSION

In most cases, the procedures you have learned/will learn in the other lessons of this stage will enable you to avoid using the ejection and ditching procedures you learned here. Since these procedures will only be accomplished when all other efforts have failed, you must know them and know them well. They are your last chance to save yourself.

## ANSWER KEY

1. 1. Press head firmly against headrest
   2. Elevate chin slightly (10 degrees)
   3. Press shoulders and back firmly against seat
   4. Hold elbows and arms firmly toward sides
   5. Press buttocks firmly against seat back
   6. Attempt to place thighs flat against seat
   7. Place heels firmly on deck, toes on rudder pedals
2. sink rate, zoom
3. beaded handles, oral inflation, collar lobe, snap
4. seat kit, raft release, life raft
5. together, slightly bent, pointed slightly downward, on the horizon, grasp firmly, tuck in prior to water entry
6. down, on, not deployed
7. 1. balls of feet
   2. calf
   3. thigh
   4. buttocks
   5. upper back
8. large, down, left, cross
9. 100; 375; 1,375; 1,300; 875
10. 280, 06, 100, 00, 150
11. 7700, external stores, raise, full
12. swell, crest
13. emergency restraint release,
14. neutralize, retract, IDLE, FULL OPPOSITE, FULL WITH, NEUTRALIZE, NEUTRALIZE
15. controllability check
    1. flying airspeed
    2. visual inspection
    3. 200, 10
    4. DOWN
    5. 5, optimum AOA, 10
    6. no-slat, Emerg Flaps, no-flap
    7. not recommended
16. 1. Senior aviator in flight
    2. Senior student in flight
    3. Any aviator airborne identifying self as senior

# LECTURE GUIDE

**COURSE/STAGE:** TS, ADV & IUT / Emergency Flight Procedures

**LESSON TITLE:** Engine and Hydraulic Emergency Procedures

**LESSON IDENTIFIER:** T-45C TS, ADV & IUT EMFP-04

**LEARNING ENVIRONMENT:** Classroom

**ALLOTTED LESSON TIME:** 1.5 hr

**TRAINING AIDS:**

* Figures
  - Fig 1: ECA Failure (Full Trim)
  - Fig 2: ECA Failure (No Trim)
  - Fig 3: Fuel Low
  - Fig 4: Engine Display
  - Fig 5: HYD 1 Pump Failure
  - Fig 6: HYD 2 Pump Failure
  - Fig 7: Total Hydraulic Failure
  - Fig 8: HYD Fail Warning/Caution Light Logic
  - Fig 9: RPM Malfunctions

**STUDY RESOURCES:**

* T-45C NATOPS Flight Manual, A1-T45AC-NFM-000
* T-45C NATOPS Pilot's Pocket Checklist, A1-T45AC-NFM-500
* Lesson Guides for Engineering, "Engine and Related Systems Malfunctions," and Engineering, "Hydraulic System Malfunctions"

**(9-98) ORIGINAL**

**LESSON PREPARATION:**

Complete:

* EMFP-05 workbook lesson, “Engine and Hydraulic Emergency Procedures”

Read:

* Emergency procedures for GTS fire, engine fire/tailpipe hot, engine fuel/fuel control, and hydraulic systems in Part V, Chapter 12, “General Emergencies,” and Chapter 15, “In-flight Emergencies,” of the T-45A NATOPS Flight Manual, A1-T45AB-NFM-000
* Associated procedures in “Emergency Procedures,” Pilot’s Pocket Checklist, A1-T45AB-NFM-500

Review:

* Lesson Guide, (Eng), “Engine and Related Systems Malfunctions”
* Lesson Guide, (Eng), “Hydraulic System Malfunctions”

**REINFORCEMENT:** N/A

**EXAMINATION:**

The objectives in this lesson will be tested in EMFP 07X.

## LESSON OBJECTIVES

**1.8.1.1.9.1.2**
Recall procedures for ECA failure

**1.8.1.2.5.2**
Recall procedures for boost pump failure

**1.8.1.2.3.2**
Recall procedures for low pressure fuel pump failure

**1.8.1.1.18.2**
Recall procedures for initial shot solenoid failure

**1.8.1.1.19.2**
Recall procedures for steam ingestion bleed valve failure

**1.8.1.2.4.2**
Recall procedures for FUEL low light

**1.8.1.2.1.2**
Recall procedures for excessive fuel consumption

**1.8.1.5.8.2**
Recall procedures for HYD accumulator failure

**1.8.1.5.4.2**
Recall procedures for HYD 1 system pressure failure

**1.8.1.5.5.2**
Recall procedures for HYD 2 system pressure failure

**1.8.1.5.3.1**
Identify indications of total hydraulic failure

**1.8.1.5.3.2**
Recall procedures for total hydraulic failure

**1.8.1.5.2.2**
Recall procedures for uncommanded RAT extension

**1.8.1.1.4.2**
Recall procedures for engine overtemp

**1.8.1.1.7.2**
Recall procedures for engine overspeed

**1.8.1.1.5.1**
Identify indications of engine stalls

**1.8.1.1.5.2**
Recall procedures for engine stalls

**1.8.1.1.8.2**
Recall procedures for engine flameout

**1.5.3.1.5.7.1**
Identify requirements for airstart

**1.5.3.1.5.7.2**
Recall procedures and techniques for airstart

**1.8.1.1.10.2**
Recall procedures for engine vibrations

**1.8.1.1.16.2**
Recall procedures for oil pressure failure

**1.9.3.1.3.2**
Identify situations requiring precautionary approach

**1.8.1.1.11.2**
Recall procedures for GTS fire (in flight)

**1.8.1.1.2.2**
Recall procedures for engine fire

**1.8.1.1.2.2.1**
Recall reasons for procedures for engine fire

**1.8.1.1.3.2**
Recall procedures for tailpipe hot (in flight)

## MOTIVATION

This lesson will enable you to make proper decisions in order to complete your mission safely should you face a fuel, engine, or hydraulic system malfunction.

## OVERVIEW

EMFP-04 provides an opportunity to analyze and discuss engine system failures. Refer to questions that you may have had in conjunction with your NATOPS review and/or how that information interfaces with material learned in the engineering block.

This lesson presents indications and emergency procedures for malfunctions in the following systems:

* Fuel/fuel control
* Hydraulic
* Engine

## REFRESHER

Recall the:

* Location and function of T-45C cockpit fuel, engine, and hydraulic system indicators, warning/caution panel (WCP), FIRE light, and MASTER ALERT light
* T-45C warning, caution and advisory lights associated with the engine system

## PRESENTATION

NOTE: *Italicized* passages are excerpted from NATOPS.

***Sg 1, fr 2***
*Lesson Organization*

**ENGINE AND HYDRAULIC EMERGENCY PROCEDURES**

* Fuel system malfunctions
* Hydraulic system malfunctions
* Engine malfunctions

I. Fuel system malfunctions

A. ECA failure **1.8.1.1.9.1.2**

*NOTE: In the unlikely event of an ECA failure in a full trim condition, fuel flow will be reduced: the EGT and rpm will decrease, and the thrust available will be governed by the maximum rpm obtained. The thrust may be reduced as much as one third of the normal full throttle value. Very low idle rpm may occur, and the throttle must be handled carefully to avoid stall or flameout.*

*NOTE: ECA total failure will, in most instances, result in a no-trim condition, increasing the rpm and EGT. The EGT and rpm must be controlled carefully within limits by throttle manipulation.* Do not exceed 90% above 20,000 feet, or 95% below 20,000 feet.

1. Indications

a. ECA failure (full trim, both lanes)

(1) MASTER ALERT light flashes and caution tone sounds

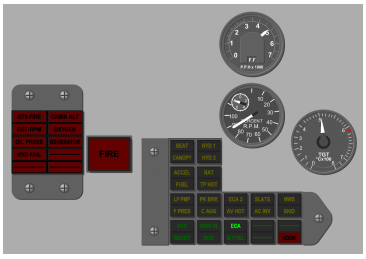
(2) ECA 2 caution light illuminates

(3) Fuel flow decreases

(4) EGT decreases

(5) RPM decreases

***Sg 1, fr 3***
*ECA Failure (Single Lane)*




***Sg 1, fr 4***
***Fig 1:*** *ECA Failure (Full Trim)*

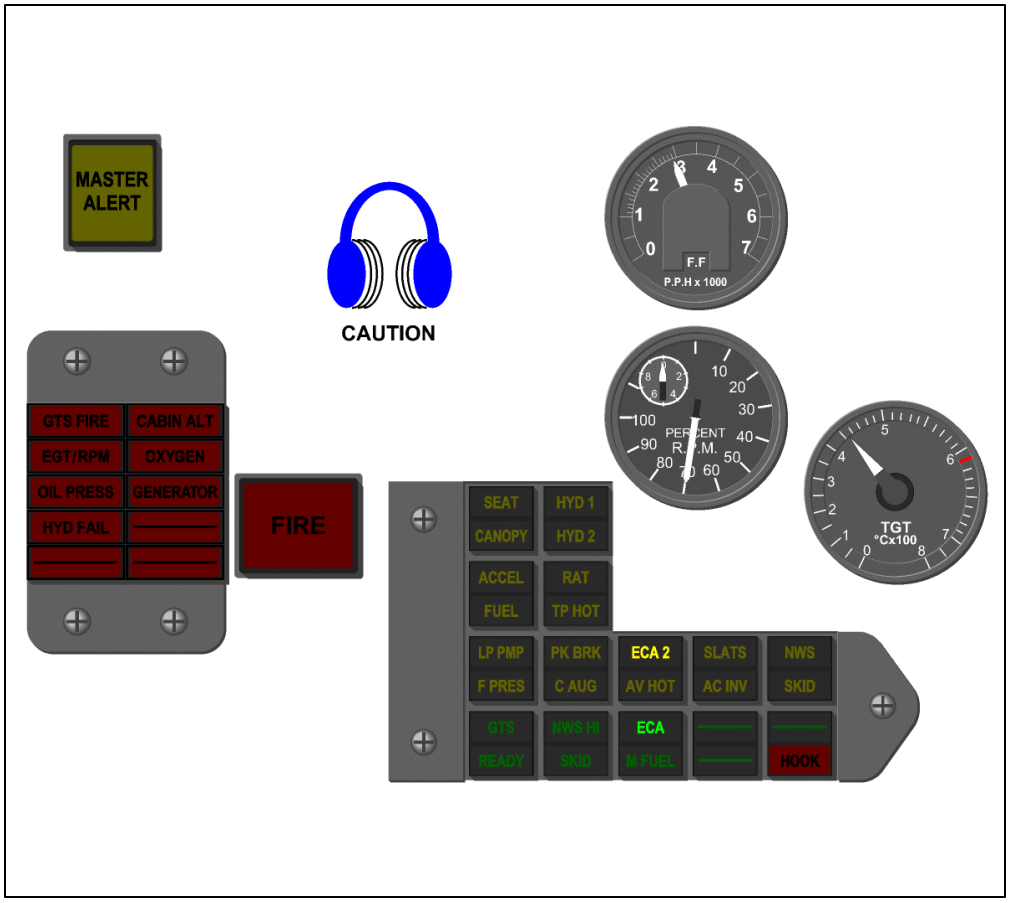



**Figure1: ECA FAILURE (FULL TRIM)**

b. ECA failure (no trim, both lanes)

(1) MASTER ALERT light flashes and caution tone sounds

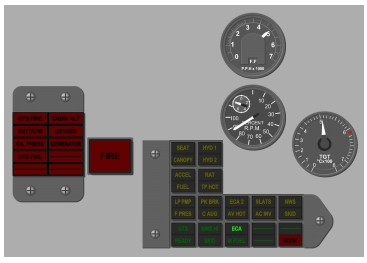
(2) ECA 2 caution light illuminates

(3) EGT increases

(4) RPM increases

(5) Fuel flow increases

***Sg 1, fr 5***
*ECA Failure (Single Lane)*



***Sg 1, fr 6***
***Fig 2:*** *ECA Failure (No Trim)*

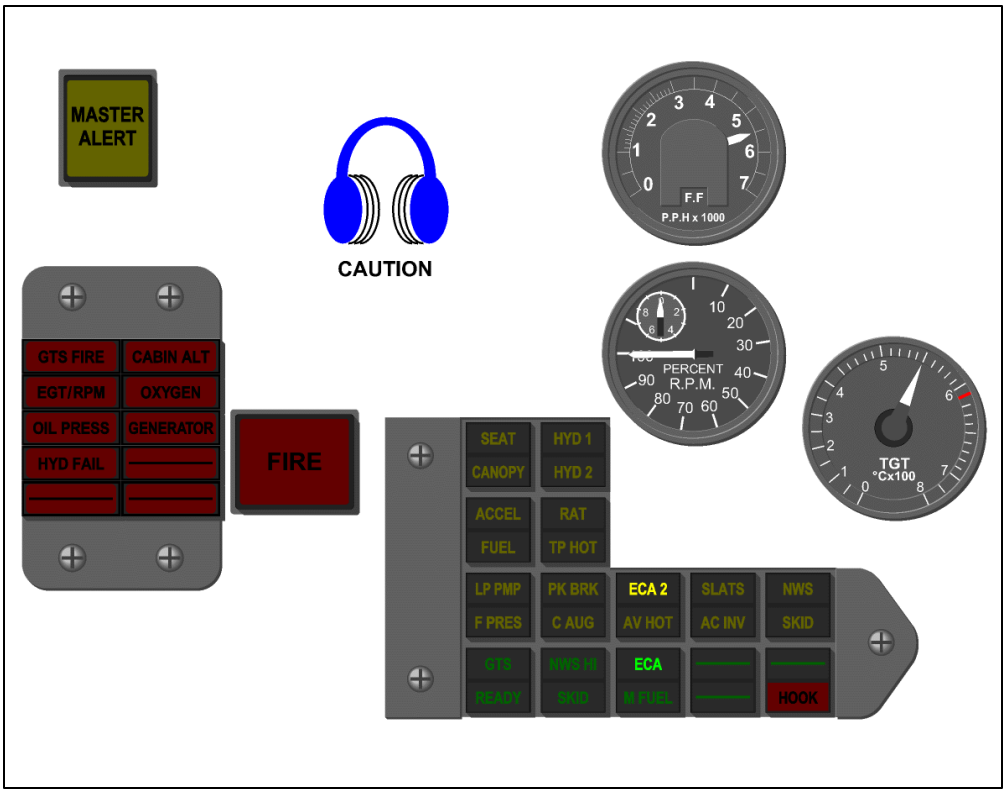


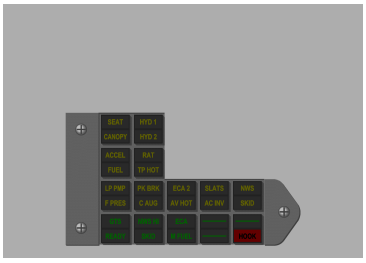

**Figure 2: ECA FAILURE (NO TRIM)**

2. Procedures - See NATOPS

**LESSON NOTES**

*Have a student explain the difference between the boost pump and low pressure fuel pump.*

***Sg 1, fr 7***
*Boost Pump or Fuel Pressurization Failure (1 Overlay)*



***Overlay 1***

B. Boost pump or fuel pressurization failure **1.8.1.2.5.2**

1. Indications

   a. MASTER ALERT light flashes and caution tone sounds

   b. F PRES caution light illuminates

2. Procedures - See NATOPS

C. Low pressure fuel pump failure **1.8.1.2.3.2**

1. Indications

a. MASTER ALERT light flashes and caution tone sounds

b. LP PMP caution light illuminates

2. Procedures - See NATOPS

D. Initial shot solenoid or steam ingestion bleed valve failure **1.8.1.1.18.2, 1.8.1.1.19.2**

1. Indications

a. MASTER ALERT light flashes and caution tone sounds

b. ACCEL caution light illuminates

2. Procedures - See NATOPS

E. Fuel quantity malfunctions

1. FUEL light **1.8.1.2.4.2**

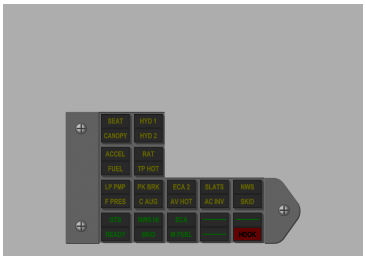
a. Indications

(1) MASTER ALERT light flashes and caution tone sounds

(2) FUEL caution light illuminates

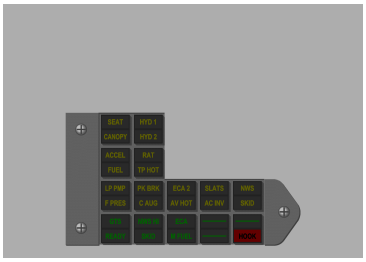
(3) Fuel quantity indicator reads approximately 350 lb depending on fuel type, temperature, and aircraft attitude

***Sg 1, fr 9***
*LP Fuel Pump Failure (1 Overlay)*



***Overlay 1***

***Sg 1, fr 11***
*Initial Shot Solenoid Failure (1 Overlay)*



***Overlay 1***

***Sg 1, fr 13***
***Fig 3:*** *Fuel Low*

***Overlay 1***

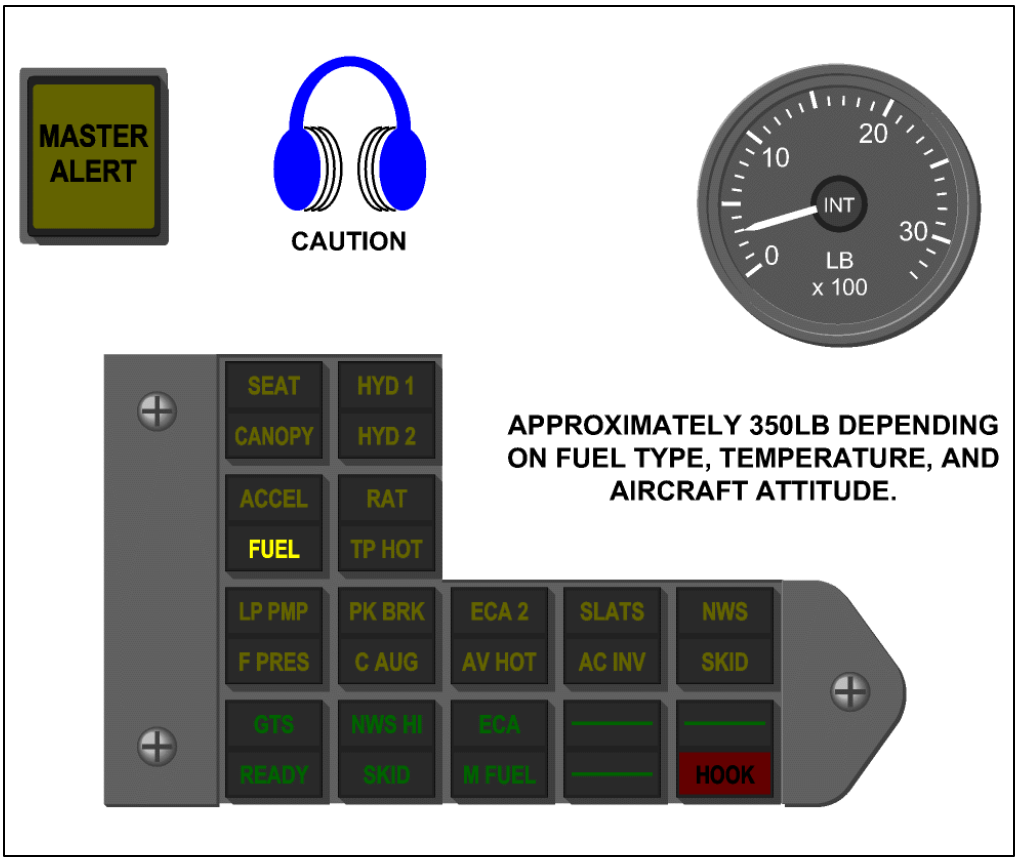



**Figure 3: FUEL LOW**

NOTE: If the fuel quantity indicator reads above 350 lb, assume that the FUEL caution light is valid--the indicator cannot be tested. If the indicator reads less than 350 lb, but the FUEL light is not illuminated, assume that the indicator is correct. Always assume that the lower of the two indications is correct.

NOTE: The most conservative altitude and speeds can be determined by using the NATOPS maximum range/endurance charts.

NOTE: The FUEL caution light is not associated with the BINGO setting.

b. Procedures - See NATOPS

2. Excessive fuel loss **1.8.1.2.1.2**

a. Indications

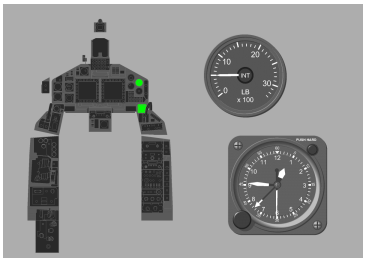
(1) Fuel quantity is significantly lower than planned

(2) Wingman notices fuel leak

NOTE: There is no accuracy test for the fuel quantity indicator, but you can cross check the fuel quantity indication on the engine display.

NOTE: Lack of a visual verification does not rule out the possibility of a leak. A leak could be more serious if it's not visible, because it might be occurring inside the engine bay.

***Sg 1, fr 16***
*Excessive Fuel Loss*



***Sg 1, fr 18***
***Fig 4:*** *Engine Display*

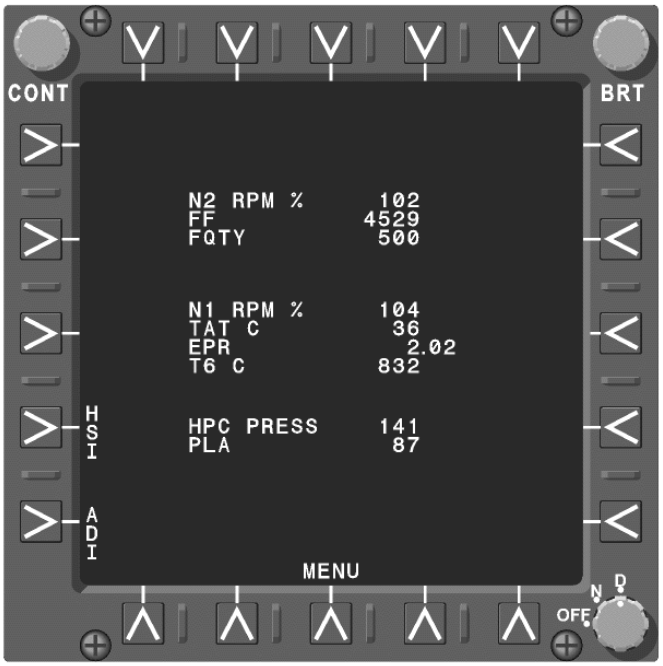



**Figure 4: ENGINE DISPLAY**

b. Procedures

(1) If possible, have wingman confirm fuel leak or venting

(2) Compute ETE or check time-to-go in TACAN or waypoint data block to a suitable landing field

(3) Land as soon as possible

**PROGRESS CHECK**

**Question 1 — 1.8.1.1.9.1.2**
**What altitude and throttle restrictions should you observe in the event of an ECA failure?**

ANSWER: Do not exceed 90% rpm above 20,000 ft or 95% rpm below 20,000 ft.

**Question 2 — 1.8.1.2.3.2**
**What are the procedures for low pressure fuel pump failure?**

ANSWER:
1. Throttle - AVOID ABRUPT MOVEMENT AND SET MINIMUM FOR FLIGHT
2. Avoid unusual attitudes
3. Land as soon as practical

**Question 3 - 1.8.1.1.18.2**
**What restrictions are imposed for an ACCEL caution light in flight?**

ANSWER:
Avoid throttle advances above 10,000 feet and abrupt throttle advances below 10,000 feet.

II. Hydraulic system malfunctions

***WARNING: Loss of all hydraulic pressure with subsequent illumination of the HYD FAIL warning light will result in loss of control of the aircraft.***

A. Hydraulic accumulator failure **1.8.1.5.8.2**

1. Indications

a. Ground: Absence of adequate accumulator pressure (1,100 ± 50 psi) prior to engine start during preflight

b. In flight

NOTE: Both systems, including accumulators, supply continuous hydraulic power to flight controls.

(1) With both hydraulic systems operating normally, there is no indication of a single accumulator failure. If one accumulator fails, then the redundant accumulator provides adequate pressure damping and reserve power.

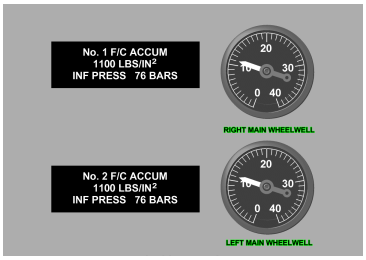
(2) If the aircraft is operating on only one hydraulic system and that system accumulator fails, or if both accumulators fail at once, then controls rely on line pressure only and flight controls may not respond smoothly, especially during periods of high demand (a large or rapid control stick displacement)

***Sg 2, fr 2***
*Lesson Organization*

**ENGINE AND HYDRAULIC EMERGENCY PROCEDURES**

* Fuel system malfunctions
* Hydraulic system malfunctions
* Engine malfunctions

***Sg 2, fr 3***
*Hydraulic Accumulator Failure (1 Overlay)*




***Overlay 1***

2. Procedures

a. Ground: initiate maintenance action

b. In flight

(1) With both hydraulic systems operating normally or only one accumulator failed, no special procedures required

(2) With both accumulators failed, more effort will be required to operate controls smoothly, especially during periods of high demand

*Sg 2, fr 5-7*
***Fig 5:*** *HYD 1 Pump Failure (2 Overlays)*

***Overlay 1***

***Overlay 2***

B. HYD 1 EDP failure **1.8.1.5.4.2**

1. Indications

a. Low pressure or loss of pressure, as indicated by HYD 1 pressure gauge

b. MASTER ALERT light flashes and caution tone sounds

c. HYD 1 caution light illuminates at 600 $\pm$ 50 psi

d. If pump failure is associated with leak, fluid loss may be visible to pilot or another aircraft

NOTE: HYD 1 pressure below 1,500 psi will result in the loss of the following equipment: landing gear (normal extension), flaps (normal extension), slats, speed breaks, nose wheel steering, launch bar (extend), normal brakes (anti-skid) and arresting hook (retract).

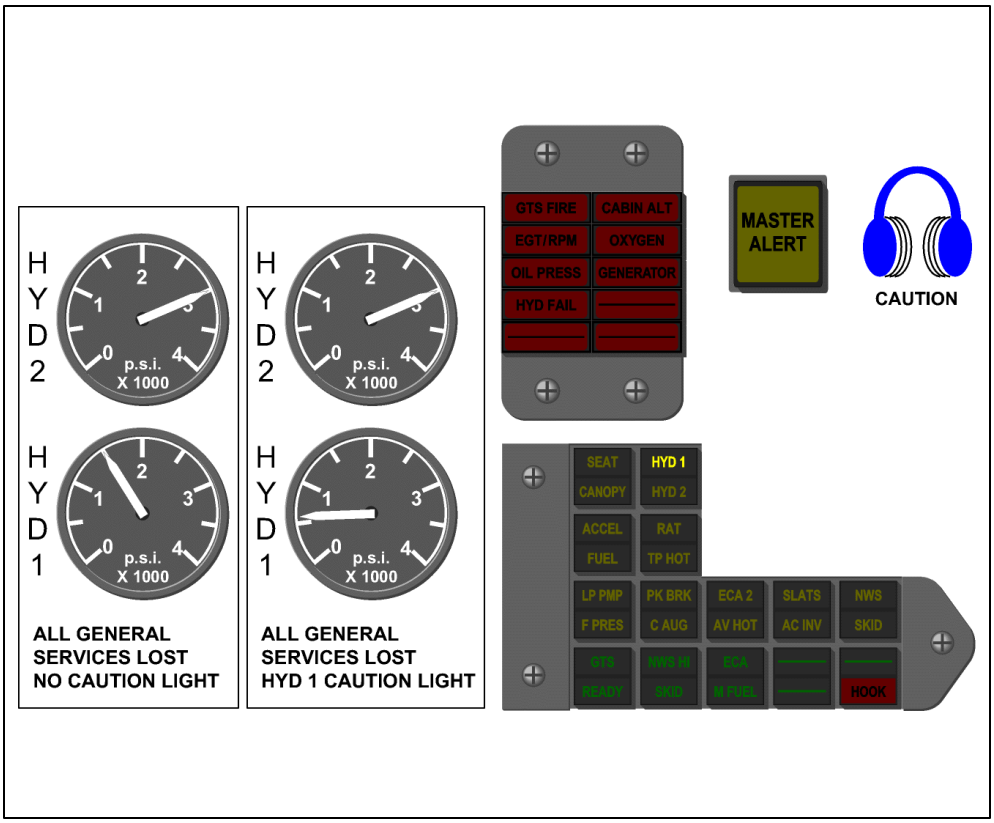



**Figure 5: HYD 1 PUMP FAILURE**

2. Procedures - See NATOPS

C. HYD 2 EDP failure **1.8.1.5.5.2**

*Sg 2, fr 8-11*
***Fig 6:*** *HYD 2 Pump Failure (3 Overlays)*

1. Indications

   a. Loss of pressure, as indicated by HYD 2 pressure gauge

   b. At 1,660 ± 110 psi

***Overlay 1***

      (1) MASTER ALERT light flashes and caution tone sounds

      (2) HYD 2 caution light illuminates

   c. Ram air turbine (RAT) extends at 1,500 psi, and HYD 2 pressure cycles between 2,500 and 3,000 psi

***Overlay 2***

NOTE: If the failure of HYD 2 results from an engine-driven pump (EDP) failure (with no leak), then pressure is supplied by the RAT through the Emergency Hydraulic system. If the failure includes a complete or continuing loss of fluid, then cycling pressure (indicative of RAT operation) may be only temporary, if it occurs at all.

*Overlay 3*

d. RAT continues to operate normally--i.e., gauge continues to fluctuate between approx 2,500 and 3,000 psi

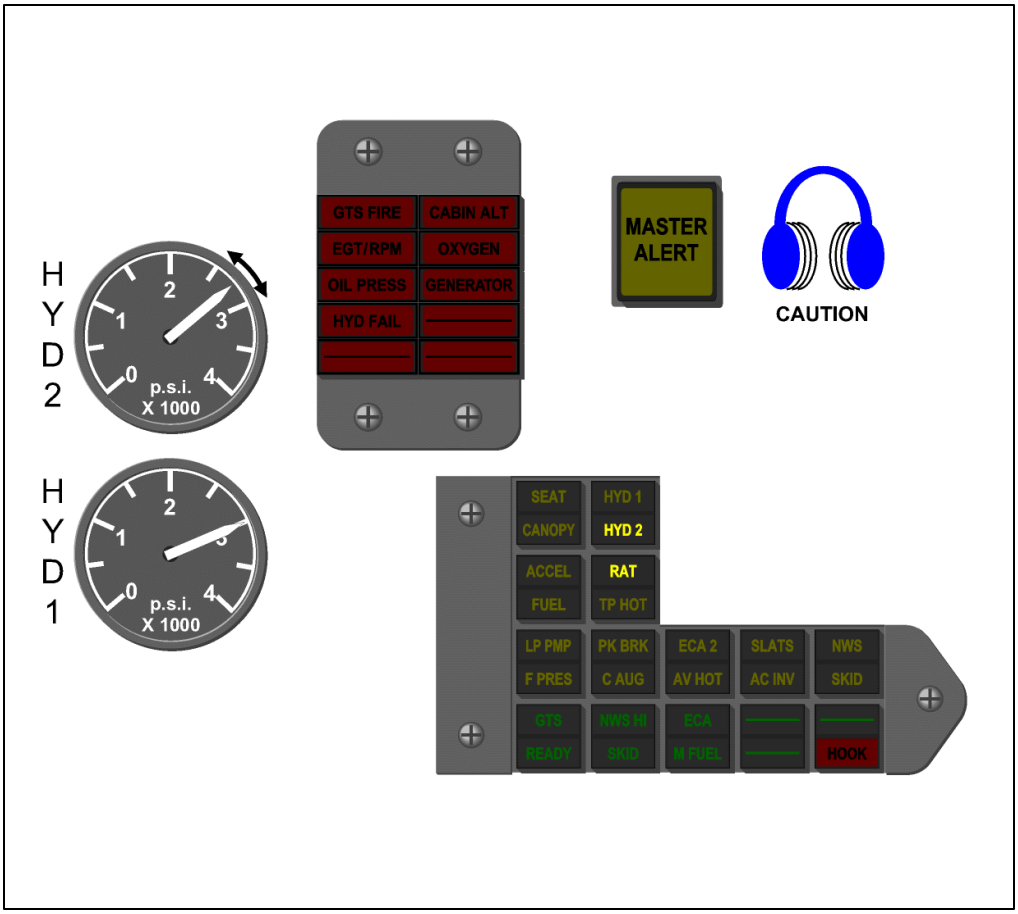



**Figure 6: HYD 2 PUMP FAILURE**

2. Procedures - See NATOPS

D. Total hydraulic system failure **1.8.1.5.3.1, 1.8.1.5.3.2**

NOTE: A HYD FAIL warning light will illuminate when hydraulic system pressures are below a predetermined value. For this to happen, a catastrophic hydraulic leak must have occurred or a failure of both the engine-driven hydraulic pumps and the RAT, the latter being highly unlikely. Proper handling of this emergency and thorough knowledge of the system is essential to the safe outcome of this emergency.

1. Indications (in sequence of occurrence)

a. MASTER ALERT light flashes and caution tone sounds

b. HYD 1 caution light illuminated

c. HYD 2 caution light illuminated

***Sg 2, fr 12***
*Summary of Hydraulic Indications*

| CONDITION | HYD 1 | HYD 2 |
|---|---|---|
| Normal Pressure | 3,000 PSI | 3,000 PSI |
| General Services Lost | 1,500 PSI | ——— |
| HYD 1 PRESS Light | 600 +/- 50 PSI | ——— |
| HYD 2 PRESS Light | ——— | 1,660 +/- 110 PSI |
| RAT Extension, RAT EXTEND Light on | ——— | 1,500 PSI |
| RAT Retraction, RAT EXTEND Light off | ——— | 700 PSI |
| HYD FAIL Light | 600 PSI and | 600 PSI |

***Sg 2, fr 13-18***
***Fig 7:*** *Total Hydraulic Failure (4 Overlays)*

***Overlay 1***

***Overlay 2***

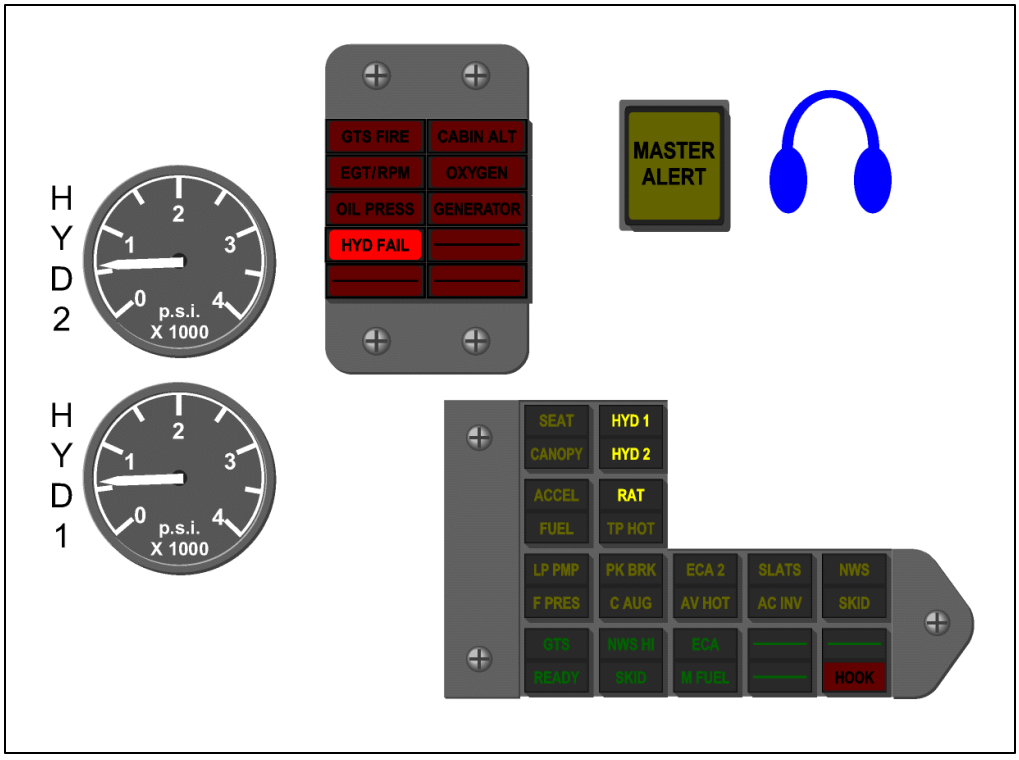



**Figure 7: TOTAL HYDRAULIC FAILURE**

*Overlay 3*

*Overlay 4*

***Sg 2, fr 19***
***Fig 8:*** *HYD FAIL Warning/Caution Light Logic*

d. Emergency Hydraulic system pressure (HYD 2 pressure gauge) less than 600 psi

e. HYD FAIL warning light illuminated

NOTE: The HYD FAIL warning light will illuminate with the HYD 1, HYD 2, and emergency HYD system failure. For the HYD FAIL warning light to illuminate, HYD 1 system pressure must be less than 600 ± 50 psi, HYD 2 system pressure less than 1,660 ± 110 psi and the emergency HYD system pressure must be less than 600 ± 50 psi.

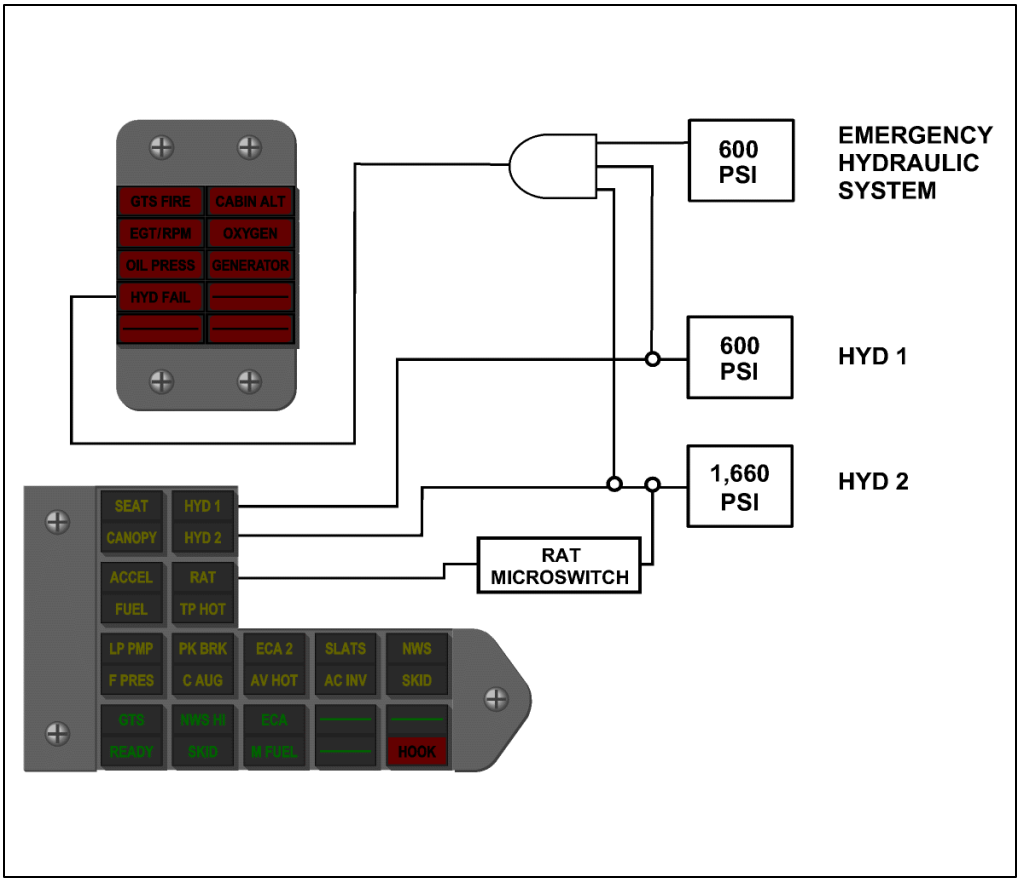



**Figure 8: HYD FAIL WARNING/CAUTION LIGHT LOGIC**

2. Procedures - See NATOPS

E. Uncommanded RAT extension **1.8.1.5.2.2**

1. Indications

   a. MASTER ALERT light flashes and caution tone sounds

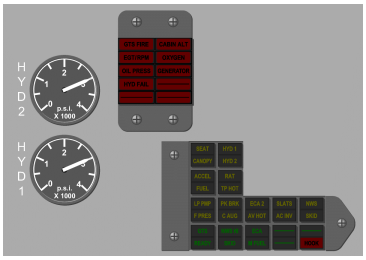
   b. RAT caution light illuminates

   c. HYD 2 pressure is normal, and HYD 2 caution light is not illuminated

      NOTE: The RAT should extend only when HYD 2 pressure drops to approximately 1,500 psi. The HYD 2 caution light should illuminate at 1,660 ± 110 psi, before the RAT extends.

2. Procedure - See NATOPS

***Sg 2, fr 20***
*Uncommanded RAT Extension (1 Overlay)*




***Overlay 1***

**PROGRESS CHECK**

**Question 4 — 1.8.1.5.4.2**
**What are the before-landing emergency procedures for HYD 1 pump failure?**

ANSWER:
1. Landing gear - EMERGENCY EXTEND
2. Emergency flap switch - DOWN
3. Anti-skid switch - OFF
4. Brakes - DO NOT TEST
5. Make short-field arrested landing, if available

**Question 5 -- 1.8.1.5.9.2**
**At what HYD 2 pressure will the RAT extend?**

ANSWER:
1,500 psi

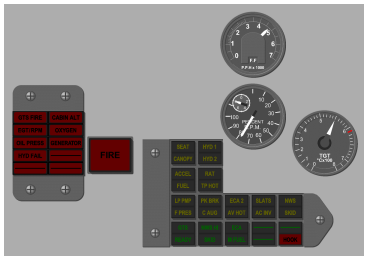
*Sg 3, fr 2*
*Lesson Organization*

**ENGINE AND HYDRAULIC EMERGENCY PROCEDURES**

* Fuel system malfunctions
* Hydraulic system malfunctions
* Engine malfunctions

*Sg 3, fr 3, pg 1*
***Fig 9:*** *RPM Malfunction (1 Overlay)*

*Sg 3, fr 5*
*EGT Malfunction (1 Overlay)*



***Overlay 1***

*Sg 3, fr 7*
***Fig 9:*** *RPM Malfunction*

III. Engine malfunctions and situations which may require precautionary approach **1.8.1.1.4.2, 1.8.1.1.7.2**

A. EGT/RPM malfunctions (in flight)

1. Indications

a. $N_1$

(1) MASTER ALERT light flashes and warning tone sounds

(2) EGT/RPM warning light illuminates when $N_1$ RPM > 112.4 $\pm$ 1% or EGT > 650 $\pm$ 8°C

b. $N_2$ RPM gauge exceeds 104%

NOTE: The EGT/RPM light will illuminate in-flight if either of the following occur: transient/ acceleration to 112.4 $\pm$ 1% $N_1$ rpm - EGT exceeds 650 $\pm$ 8° C.

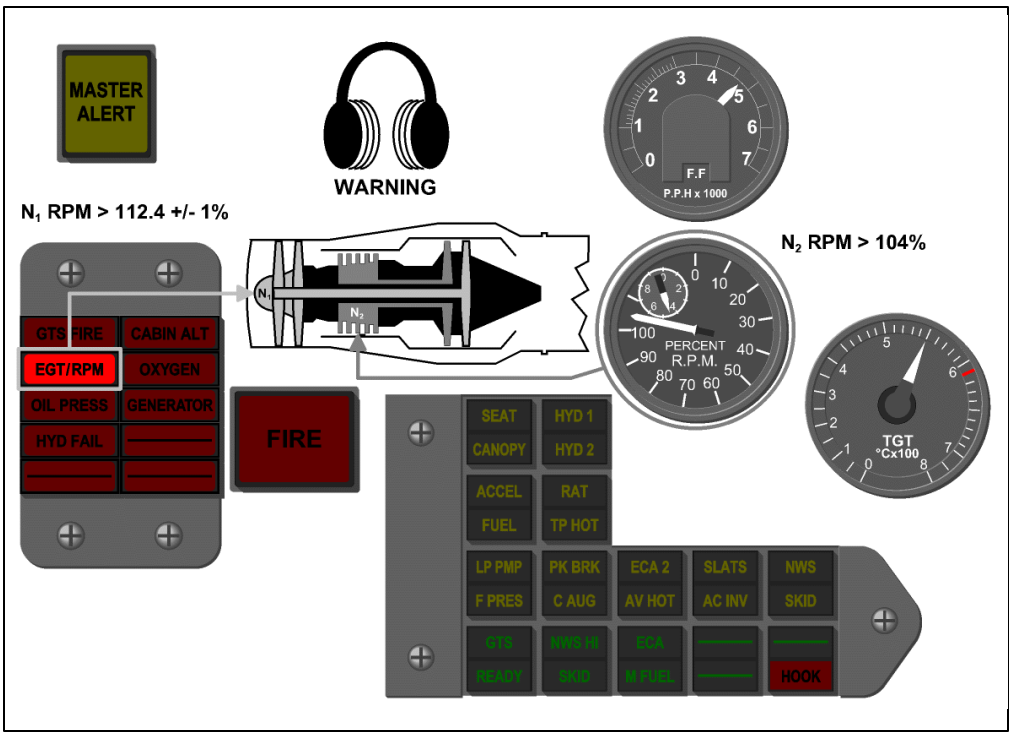



**Figure 9: RPM MALFUNCTIONS**

**LESSON NOTES**

*Emphasize that an indication of 104% $N_2$ RPM indicates engine overspeed whether or not the EGT/RPM warning light is on. Also emphasize that with the EGT/RPM warning light on, $N_2$ RPM indications may be normal. N RPM can only be checked on the engine display page.*

2. Procedures - See NATOPS

B. Engine stall **1.8.1.1.5.1, 1.8.1.1.5.2**

**LESSON NOTES**

*Give the students examples of how engine stalls can be confused with other malfunctions.*

1. Indications

   a. Loud banging or popping noises

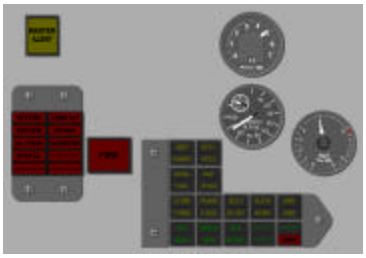
   b. Increasing EGT

   c. Decreasing or fluctuating rpm

2. Procedures - See NATOPS

C. Engine failure (flameout) **1.8.1.1.8.2**

***Sg 3, fr 8***
*Engine Flameout*
*(1 Overlay)*



**LESSON NOTES**

*Give the students examples of situations and maneuvers that can produce a flameout.*

***Overlay 1***

1. Indications

   a. Engine winding down

   b. Loss of thrust

   c. Several warning/caution lights and tones due to generator loss

   d. Decreasing fuel flow

   e. Decreasing EGT

   f. Decreasing rpm

      NOTE: When the rpm decreases enough to drop HYD 2 to 1,500 psi, the RAT will extend and provide pressure for flight controls.

   g. As rpm decreases, MASTER ALERT flashes, warning and caution lights illuminate, and associated tones sound

      (1) GENERATOR warning light

         (a) Right MFDs go blank

         (b) Left MFDs revert to ADI display

      (2) OIL PRESS warning light

      (3) HYD 1 caution light

      (4) HYD 2 caution light

      (5) RAT caution light

      (6) F PRES caution light

      (7) Other warning/caution lights will illuminate as systems fail due to decreasing rpm

NOTE: Under normal conditions an engine flameout would be followed by an "Immediate Airstart". The parameters defined by altitude, and/or airspeed will dictate your course of action.

D. Airstart procedures - See NATOPS

1. Airstart parameters/requirements **1.5.3.1.5.7.1**

a. Immediate - Any airspeed any altitude

b. Windmill - Below 25,000' MSL, 13% $N_2$ or greater RPM (Recommended a minimum of 250 knots)

c. Assisted - Below 15,000' MSL, Airspeed 165 - 250 knots

2. Airstart procedures - See NATOPS **1.5.3.1.5.7.2**

NOTE: Engine flameout indications generally consist of falling rpm and EGT with corresponding reduction in thrust. The airstart procedures you will use are divided into three categories--immediate, windmill, and assisted. It is important to quickly identify and initiate the procedure appropriate to the situation.

a. Immediate Airstart - These procedures will precede both the Windmill Airstart and the Assisted Airstart attempts in all cases

**LESSON NOTE**

Emphasize to the class the importance of timely execution of the engine failure procedures above 1,500 feet AGL or airspeed above 180 KIAS. When the engine fails, the OBOGS system no longer is functional. The pilot's only source of oxygen is the EMERGENCY OXYGEN system in the seat.

b. Failure to relight procedures - See NATOPS

NOTE: Once an Immediate Airstart has been attempted and was unsuccessful, the decision to eject or make another airstart attempt using the Windmilling or Assisted Airstart procedures must be made. In a case such as this, the appropriate course of action is governed by altitude, airspeed, engine $N_2$ RPM aircraft condition, and common sense. The airstart procedures listed below provide alternatives relative to flight envelope should the Immediate Airstart procedure be unsuccessful.

c. Windmill airstart procedures - See NATOPS

**LESSON NOTE**

Explain to the class that windmilling RPM may fall to zero during prolonged descent at low airspeed due to engine accessory loads. 0 RPM is normally not an indication of mechanical failure (engine seizure) unless "preceded" by other symptoms. If windmilling RPM falls below 13%, use assisted airstart procedure once in the envelope. If RPM is "0", attempt an assisted airstart by pressing the GTS button. In the case where 0 rpm was indicated, DO NOT introduce fuel (throttle to idle), unless a minimum of 15% rpm has been achieved.

d. Assisted airstart procedures - See NATOPS

**LESSON NOTE**

Discuss with the class how the GTS is used in all airstart procedures. Point out that the difference between the use of the GTS in the Assisted airstart and the other start procedures is that the Assisted airstart actively uses the pressurized GTS turbine air to turn the starter and crank the engine.

e. Successful airstart procedures - See NATOPS

E. Engine vibrations **1.8.1.1.10.2**

1. Indications

NOTE: Vibration may be associated with the engine, accessories, airframe, landing gear, pressurization, or RAT.

a. Rumbling noise

b. Vibrating airframe

2. Procedures - See NATOPS

F. Oil system failure **1.8.1.1.16.2, 1.9.3.1.3.2**

1. Indication

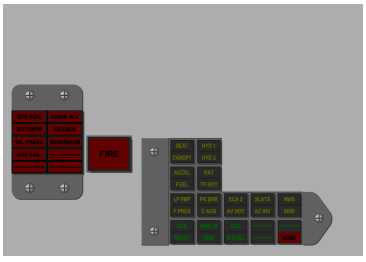
a. MASTER ALERT light flashes and warning tone sounds

b. OIL PRESS warning light illuminates

c. Possible aircraft vibration if malfunction associated with bearing failure

d. Possible engine overtemp

***Sg 3, fr 10***
*Oil System Failure*
*(1 Overlay)*



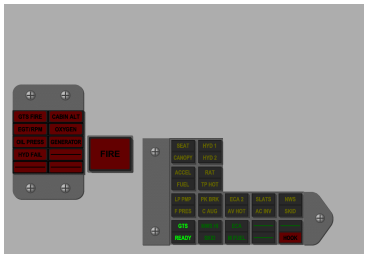

***Overlay 1***

e. Wingman may see leaking oil or excessive exhaust smoke

2. Procedures - See NATOPS

G. GTS (in flight) fire **1.8.1.1.11.2**

***Sg 3, fr 12***
*GTS Fire (1 Overlay)*




***Overlay 1***

1. Indications

a. MASTER ALERT light flashes and warning tone sounds

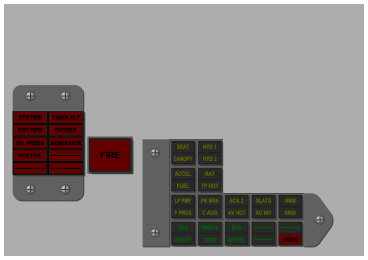
b. GTS FIRE warning light illuminates

c. Smoke or fire detected by pilot

2. Procedures - See NATOPS

H. Engine fire (in flight) **1.8.1.1.2.2, 1.8.1.1.2.2.1**

***Sg 3, fr 14***
*Engine Fire (1 Overlay)*




***Overlay 1***

1. Indications

*NOTE: The first indication of fire is normally illumination of the FIRE warning light (accompanied by audible warning tone). Engine fire may be accompanied by one or more of the following: rising EGT, excessive fuel flow, erratic or rough engine operation, or visible flames or smoke trail. The check for secondary indications includes EGT/RPM and/or OIL PRESS warning light, HYD 1, HYD 2, TP HOT caution lights, abnormal fuel flow, and visible signs of smoke.*

a. MASTER ALERT light flashes and warning/ caution tones sound

b. FIRE warning light illuminate

c. Possible abnormal EGT or fuel flow

d. Possible fire or smoke

2. Procedures - See NATOPS

l. Tailpipe hot (in flight) **1.8.1.1.3.2**

NOTE: The tailpipe hot sensor element is located in the tailpipe bay aft of the engine compartment and firewall. The illumination of the TP HOT caution light may be an indication of a tailpipe bay fire. Immediate implementation of the tailpipe hot procedures and proper monitoring for secondary indications is essential for proper handling of this problem.

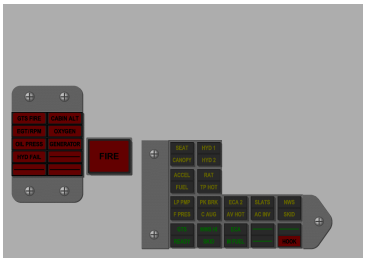
1. Indications:

   a. MASTER ALERT light flashes and warning/ caution tones sound

   b. TP HOT caution light illuminates

2. Procedures - See NATOPS

***Sg 3, fr 16***
*Tailpipe Hot*
*(1 Overlay)*




***Overlay 1***

**PROGRESS CHECK**

**Question 6 — 1.8.1.1.5.1**
**What are the indications of an engine stall?**

ANSWER:
1. Loud banging or popping noises
2. Increasing EGT
3. Decreasing or fluctuating rpm

**Question 7 — 1.5.3.1.5.7.2**
**What fuel control mode should you select during relight if you suspect main engine fuel system failure?**

ANSWER: MANUAL

***Sg 10, fr 2***
*Review Menu*

## SUMMARY

This lesson has presented indications and emergency procedures for malfunctions in the following systems:

* Fuel/fuel control
* Hydraulic
* Engine

## CONCLUSION

The emergency conditions described in this lesson may occur in isolation or in conjunction with other malfunctions, perhaps in different systems. For example, an engine overtemp may result in engine failure, engine fire, or hydraulic failure. Multiple malfunctions are not unheard of.

# LESSON GUIDE

**COURSE/STAGE:** TS, ADV & IUT / Emergency Flight Procedures

**LESSON TITLE:** Engine and Hydraulic Emergency Procedures

**LESSON IDENTIFIER:** T-45C TS, ADV & IUT EMFP-05

**LEARNING ENVIRONMENT:** CAI

**ALLOTTED LESSON TIME:** 1.5 hr

**STUDY RESOURCES:**

* T-45C NATOPS Flight Manual, A1-T45AC-NFM-000
* T-45C NATOPS Pilot's Pocket Checklist, A1-T45AC-NFM-500
* Emergency Flight Procedure-05, Engine and Hydraulic Emergency Procedures

**LESSON PREPARATION:**

Read:

* Emergency procedures concerning the engine and hydraulic systems in Part V, "Emergency Procedures," in the T-45C NATOPS Flight Manual, A1-T45AC-NFM-000, and "Emergency Procedures" in the T-45C NATOPS Pilot's Pocket Checklist, A1-T45AC-NFM-500

Review:

* Lecture Guide, EMFP-04, "Engine and Hydraulic Emergency Procedures"
* Lecture Guide, ENG-04, "Engine and Related Systems"
* Lesson Guide, ENG-05, "Engine System and Related Systems Malfunctions"
* Lesson Guide, ENG-06, "Engine System Malfunctions"
* Lecture Guide, ENG-09, "Hydraulic System"
* Lesson Guide, ENG-10, "Hydraulic System Malfunctions"

**(9-98) ORIGINAL**

**REINFORCEMENT:** N/A

**EXAMINATION:**

The objectives in this lesson will be tested in EMFP 06X.

## LESSON OBJECTIVES

**1.8.1.1.9.1.2**
Recall procedures for ECA failure

**1.8.1.2.5.2**
Recall procedures for boost pump failure

**1.8.1.2.3.2**
Recall procedures for low pressure fuel pump failure

**1.8.1.5.4.2**
Recall procedures for HYD 1 EDP failure

**1.8.1.5.5.2**
Recall procedures for HYD 2 EDP failure

**1.8.1.5.1.2**
Recall procedures for RAT failure

**1.8.1.5.9.2**
Recall procedures for HYD 1 and 2 failure (RAT operating)

**1.8.1.5.3.1**
Identify indications of total hydraulic failure

**1.8.1.5.3.2**
Recall procedures for total hydraulic failure

**1.8.1.5.2.2**
Recall procedures for uncommanded RAT extension

**1.8.1.1.5.1**
Identify indications of engine stalls

**1.8.1.1.5.2**
Recall procedures for engine stalls

**1.5.3.1.5.7.1**
Identify requirements for airstart

**1.5.3.1.5.7.2**
Recall procedures for procedures and techniques for airstart

**1.8.1.1.10.2**
Recall procedures for engine vibrations

**1.8.1.1.16.2**
Recall procedures for oil pressure failure

**1.8.1.1.11.2**
Recall procedures for GTS fire (in flight)

**1.8.1.1.2.2**
Recall procedures for engine fire/tailpipe hot

**1.8.1.1.4.2**
Recall procedures for engine overtemp

**1.8.1.1.15.2**
Recall procedures for engine seizure

## MOTIVATION

This lesson focuses on engine and hydraulic failures. A substantial redundancy has been built into the T-45C to help get your aircraft safely on the ground when malfunctions result in emergencies involving these systems. The exercises in this lesson will help you learn and apply appropriate procedures.

## OVERVIEW

The goals of this lesson are to familiarize you with the engine and hydraulic emergency procedures in the NATOPS and prepare you for Emergency Procedure simulator events.

This lesson provides NATOPS exercises for emergency procedures associated with the following systems:

* Fuel
* Engine
* Hydraulic

This lesson is presented in three basic phases:

* Instruction Phase

  The student will be guided "hands-on" through the emergency procedure with audio and on-screen text prompts. Completion of the instruction for the procedure qualifies the student to select that specific procedure from the Practice menu.

* Practice Phase

  The student may select any of the emergency procedures for which he/she has completed the instruction phase of training. The Practice session will identify the procedure being practiced in the header at the top of the screen, but will not tell the student which step to perform or how to perform it. Practice sessions demand proper action in the proper sequence. Feedback is given and the opportunity to attempt the procedure again if an error is made. If desired, the student may retake an instructional section.

* Random Practice

  Once all the Practice Phase elements have been successfully completed, the student may elect to have the computer select emergency situations at random for practice.

There are three major differences between the Practice Phase and the Random Practice Phase.

1. In the Practice Phase, the emergency procedure is identified in the header at the top of the screen. In Random Practice the emergency is not identified.

2. At the completion of the Random Practice or when a step is incorrect, the lesson will ask you to identify which emergency procedure you are attempting.

3. Random Practice is not a lesson completion requirement. It is an opportunity for you to test yourself at a higher level. It is also an excellent means to review for a check flight when the simulator is not available.

## REFRESHER

Recall the:

* Location and function of T-45C cockpit engine and hydraulic system indicators, the warning and caution/advisory panels, and the FIRE and MASTER ALERT lights.

## PRESENTATION

I. Recall procedures for ECA Failure **1.8.1.1.9.1.2**

   A. Indications

      1. One lane of the two ECA lanes has failed

a. ECA advisory light illuminates

b. No action required

2. Both ECA lanes fail

a. ECA 2 caution light illuminates

b. Caution tone sounds

c. MASTER ALERT flashes

d. EGT and RPM

(1) ECA full trim failure - EGT and rpm drop and thrust may be reduced by as much as one third

(2) ECA no trim failure - EGT and rpm increase and must be controlled carefully with the throttle

B. Procedures - Refer to Part V, Chapter 12, General Emergencies, of the T-45C NATOPS

II. Recall procedures for Boost Pump Failure **1.8.1.2.5.2**

A. Indications

1. F PRES caution light illuminates

2. Caution tone sounds

3. MASTER ALERT flashes

4. Indicates either a boost pump or fuel pressurization failure

5. Procedure the same for either failure

B. Procedures - Refer to Part V, Chapter 12, General Emergencies, of the T-45C NATOPS

III. Recall procedures for Low Pressure Fuel Pump Failure **1.8.1.2.3.2**

A. Indications

1. LP PMP caution light illuminates
2. Caution tone sounds
3. MASTER ALERT flashes

B. Procedures - Refer to Part V, Chapter 12, General Emergencies, of the T-45C NATOPS

IV. Recall procedures for HYD 1 EDP Failure **1.8.1.5.4.2**

A. Indications

1. HYD 1 caution light illuminates
2. Caution tone sounds
3. MASTER ALERT flashes
4. HYD 1 pressure less than 600 psi

B. Procedures - Refer to Part V, Chapter 12, General Emergencies, of the T-45C NATOPS

V. Recall procedures for HYD 2 EDP Failure **1.8.1.5.5.2**

A. Indications

1. HYD 2 caution light illuminates
2. RAT caution light illuminates
3. Caution tone sounds
4. MASTER ALERT flashes
5. HYD 2 pressure cycles between 2,500 and 3,000 psi

B. Procedures - Refer to Part V, Chapter 12, General Emergencies, of the T-45C NATOPS

VI. Recall procedures for RAT Failure **1.8.1.5.1.2**

A. Indications

1. RAT fails to extend

a. HYD 2 caution light illuminated

b. HYD 2 pressure not fluctuating and less than 1500 psi

c. RAT caution light not illuminated

2. RAT extends but fails to operate

a. HYD 2 caution light illuminated

b. RAT caution light illuminated

c. HYD 2 pressure not fluctuating and less than 1500 psi

B. Procedures - Execute the HYD 2 failure procedures

VII. Recall procedures for HYD 1 and 2 failure (RAT operating) **1.8.1.5.9.2**

A. Indications

1. HYD 1 caution light illuminated

2. HYD 2 caution light illuminated

3. RAT caution light illuminated

4. Caution tone sounds

5. MASTER ALERT flashes

6. HYD 2 pressure cycles between 2,500 and 3,000 psi

B. Procedures - HYD 1 failure procedures

VIII. Identify indications of Total Hydraulic Failure, recall procedures for Total Hydraulic Failure **1.8.1.5.3.1, 1.8.1.5.3.2**

A. Indications

1. HYD 1 caution light illuminated

2. HYD 2 caution light illuminated

3. RAT caution light illuminated

4. Caution tone sounds

5. Emergency system pressure (HYD 2 pressure gauge) less than 600 psi

6. HYD FAIL warning light illuminated

7. MASTER ALERT flashes

8. No HYD 1 and 2 pressure indication

B. Procedure - Refer to Part V, Chapter 12, General Emergencies, of the T-45C NATOPS

IX. Recall procedures for Uncommanded RAT Extension **1.8.1.5.2.2**

A. Indications

1. RAT caution light Illuminates

2. Caution tone sounds

3. MASTER ALERT flashes

4. HYD 2 caution light not illuminated (rpm greater than 80%)

5. Normal HYD 2 pressure

B. Procedures - Refer to Part V, Chapter 12, General Emergencies, of the T-45C NATOPS

X. Identify indications of Engine Stalls, recall procedures for Engine Stalls **1.8.1.1.5.1, 1.8.1.1.5.2**

A. Indications

1. Audible bang or series of bangs from the engine

2. Sudden increase in EGT and decrease in rpm

B. Procedures - Refer to Part V, Chapter 15, In-Flight Emergencies, of the T-45C NATOPS

XI. Identify requirements for Airstart, recall procedures for Procedures and Techniques for Airstart **1.8.1.1.8.2, 1.5.3.1.5.7.1, 1.5.3.1.5.7.2**

A. Indications

1. Feel loss of the thrust

2. No response to throttle movement

3. Hear engine winding down

4. Engine instruments decreasing

5. GENERATOR warning light

6. Warning tone sounds

7. MASTER ALERT flashes

B. Requirements for Airstart - Must be above 1,500 feet AGL or airspeed greater than 180 kts

C. Procedures - Refer to Part V, Chapter 15, In-Flight Emergencies, of the T-45C NATOPS

1. Windmilling airstarts are more favorable if rpm is above 13%

2. Increase airspeed and reduce altitude with throttle at idle if rpm stagnates at 30 to 40% during satisfactory relight at high altitude low airspeed

XII. Recall procedures for Engine Vibrations **1.8.1.1.10.2**

A. Indications

1. Feel vibration in airframe

2. Possible increase in EGT and decrease in rpm

B. Procedures - Refer to Part V, Chapter 15, In-Flight Emergencies, of the T-45C NATOPS

XIII. Recall procedures for Oil Pressure Failure **1.8.1.1.16.2**

A. Indications

1. OIL PRESS warning illuminates

2. Warning tone sounds

3. MASTER ALERT flashes

4. Possible aircraft vibrations if malfunction associated with bearing failure

5. Possible engine overtemp

6. Wingman may see leaking oil or excessive exhaust smoke

B. Procedures - Refer to Part V, Chapter 12, General Emergencies, of the T-45C NATOPS

XIV. Recall procedures for GTS Fire (in flight) **1.8.1.1.11.2**

A. Indications

1. GTS FIRE warning illuminates

2. Warning tone sounds

3. MASTER ALERT flashes

4. Smoke or fire reported from GTS area

B. Procedures - Refer to Part V, Chapter 12, General Emergencies, of the T-45C NATOPS

XV. Recall procedures for Engine Fire/Tailpipe Hot **1.8.1.1.2.2**

A. Engine Fire

1. Indications -- Engine Fire

a. FIRE warning illuminates

b. May be accompanied by TP HOT caution light illuminates

c. Warning tone sounds

d. MASTER ALERT flashes

2. Procedures - Refer to Part V, Chapter 12, General Emergencies, of the T-45C NATOPS

B. Tailpipe Hot

1. Indications -- Tailpipe Hot

a. TP HOT caution illuminates

b. Caution tone sounds

c. MASTER ALERT flashes

2. Procedures - Refer to Part V, Chapter 12, General Emergencies, of the T-45C NATOPS

XVI. Recall procedures for Engine Overtemp **1.8.1.1.4.2**

A. Indications

1. EGT/RPM warning illuminates

2. Warning tone sounds

3. MASTER ALERT flashes

4. EGT exceeds 650$^{o}$C or $N_1$ exceeds 112.4 +/- 1% rpm

B. Procedures - Refer to Part V, Chapter 12, General Emergencies, of the T-45C NATOPS

XVII. Recall procedures for Engine Seizure **1.8.1.1.15.2**

A. Indications

1. RPM - 0%

2. RPM remains at 0% and READY advisory light does not illuminate during GTS assisted start

3. Maximum range gliding distance severely reduced

B. Procedures - Controlled ejection if time permits

## SUMMARY

This lesson provided NATOPS exercises for emergencies procedures associated with the following systems:

* Fuel
* Engine
* Hydraulic

## CONCLUSION

You should finish this lesson with the ability to recognize system malfunctions and to make safe logical decisions about how to deal with them. You'll have many opportunities in the simulator to practice coping with the emergencies discussed in this lesson. You cannot practice them too much. The safe completion of some future mission may depend on your ability to correctly evaluate a malfunction and act accordingly.

# LECTURE GUIDE

**COURSE/STAGE:** TS, ADV & IUT / Emergency Flight Procedures

**LESSON TITLE:** Canopy and Flight Control Emergency Procedures

**LESSON IDENTIFIER:** T-45C TS, ADV & IUT EMFP-07

**LEARNING ENVIRONMENT:** Classroom

**ALLOTTED LESSON TIME:** 1 hr

**STUDY RESOURCES:**

* T-45C NATOPS Flight Manual, A1-T45AC-NFM-000
* T-45C NATOPS Pilot's Pocket Checklist, A1-T45AC-NFM-500
* Lesson Guides for Engineering, "Hydraulic Subsystems Malfunctions," Engineering, "Flight Control System Malfunctions," and Engineering, "Canopy and Ejection Seat Systems Malfunctions"

**(9-98) ORIGINAL**

**LESSON PREPARATION:**

Complete:

* EMFP-07 homework lesson, “Canopy and Flight Control Emergency Procedures”

Review:

* Emergency procedures concerning trim, flaps, and canopy in Chapter 15, “In-Flight Emergencies” and Chapter 16, “Landing Emergencies,” in the T-45C NATOPS Flight Manual, A1-T45AC-NFM-000
* Associated procedures in “Emergency Procedures” in the Pilot’s Pocket Checklist, , A1-T45AC-NFM-500
* Part I, “The Aircraft,” of the T-45C NATOPS Flight Manual, A1-T45AC-NFM-000
* Lesson Guide, (Eng), “Hydraulic Subsystems Malfunctions”
* Lesson Guide, (Eng), “Flight Control System Malfunctions”
* Lesson Guide, (Eng), “Egress System Malfunctions”

**REINFORCEMENT:** N/A

**EXAMINATION:**

The objectives in this lesson will be tested in EMFP-11X.

## LESSON OBJECTIVES

**1.8.1.6.8.1.1**
Recall indications of speed brake failure (fails to retract)

**1.8.1.6.8.2**
Recall procedures for speed brake failure (fails to retract)

**1.5.4.7.1.1**
Recall indications of trim malfunctions

**1.9.3.13.1.1**
Recall indications of trim malfunctions in landing pattern

**1.8.1.6.7.1.1**
Recall indications of aileron trim failure

**1.8.1.6.4.1.1**
Recall indications of stabilator trim failure

**1.8.1.6.1.1**
Identify indications for runaway rudder trim

**1.5.4.7.2**
Recall procedures for trim malfunctions

**1.8.1.6.4.2**
Recall procedures for stabilator trim failure

**1.8.1.6.5.2**
Recall procedures for runaway stabilator trim (up or down)

**1.8.1.6.7.2**
Recall procedures for aileron trim failure

**1.8.1.6.1.2**
Recall procedures for runaway rudder trim

**1.8.1.6.6.2**
Recall procedures for runaway aileron trim

**1.8.1.6.3.1**
Recall rudder hardover condition

**1.8.1.8.3.1**
Recall indications of flap indicator failure

**1.8.1.6.13.2**
Recall procedures for split flaps

**1.8.1.6.11.1**
Recall indications of flaps failing to extend

**1.8.1.6.11.1.1**
Recall procedures for flaps failing to extend

**1.8.1.6.15.1**
Identify indications of slat failure

**1.8.1.6.14.2**
Recall procedures for split slats

**1.8.1.6.1.4**
Recall procedures for control augmentation failure

**1.5.4.4.2**
Recall procedures for canopy unlocked

**1.8.1.10.7.2**
Recall procedures for lost canopy

## MOTIVATION

Flight control malfunctions can result in anything from varying degrees of annoyance to a class-A disaster depending on their severity and the circumstances during which they occur. Be sensitive to their impact on the remainder of your planned flight.

## OVERVIEW

The goal of this lesson is to increase your ability to make the proper decisions when faced with a system malfunction.

This lesson presents emergency procedures for the following situations:

* Speed brake failure
* Trim failure/runaway
* Flap/slat malfunctions
* Control augmentation failure
* Canopy unlocked/lost

## REFRESHER

Recall:

* That the T-45C ailerons, stabilator, speed brakes, flaps, and slats are hydraulically operated
* The location and function of T-45C flight controls, trim control, and indicators
* The T-45C warning and caution advisory panel lights associated with the canopy, control augmentation, and flight control systems

## PRESENTATION

NOTE: Procedural steps preceded by an asterisk (*) are considered immediate action items. You must be able to accomplish these steps without reference to the checklist.

*Sg 1, fr 2*
*Lesson Organization*

**CANOPY AND FLIGHT CONTROL EMERGENCY PROCEDURES**

* **Speed brake failure**
* Trim malfunctions
* Flap/slat malfunctions
* Control augmentation failure
* Canopy

I. Speed brake failure (fails to retract) **1.8.1.6.8.1.1, 1.8.1.6.8.2**

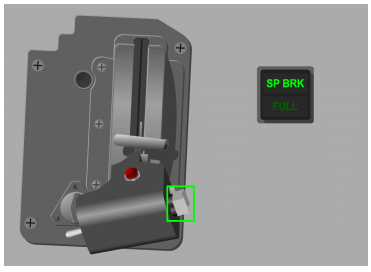
A. Indications

1. SP BRK advisory light illuminated
2. Lack of aircraft acceleration
3. Continued noise or buffeting
4. Visual confirmation by wingman

B. Procedures

1. Attempt to retract from both cockpits, if able
2. Airspeed - MAX RANGE OR MAX ENDURANCE AS THE SITUATION DICTATES
3. Land as soon as practical

*Sg 1, fr 3*
*Speed Brake Fails to Retract*



II. Trim Failure/Runaway

A. Indications **1.5.4.7.1.1, 1.9.3.13.1.1**

1. Ailerons **1.8.1.6.7.1.1**

a. Runaway trim

(1) Uncommanded left or right slow roll

(2) Lateral stick pressure required for straight and level flight

(3) Trim indicator shows trim out of position

b. Trim failure

(1) Fail to respond to aileron trim inputs

(2) Trim indicator needle fails to move with trim inputs

2. Stabilator **1.8.1.6.4.1.1**

***CAUTION: The stabilator position indicator will move as pitch commands or trim inputs are made. The indicator will only depict trim position with no forces on the stick. While setting trim for takeoff or catapult launch, it is important that both pilots not exert longitudinal forces on the stick.***

a. Runaway trim

(1) Uncommanded pitch up or down

(2) Longitudinal stick pressure required for straight and level flight

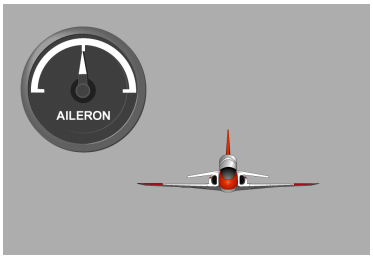
(3) Trim indicator shows trim out of position

***Sg 2, fr 2***
*Lesson Organization*

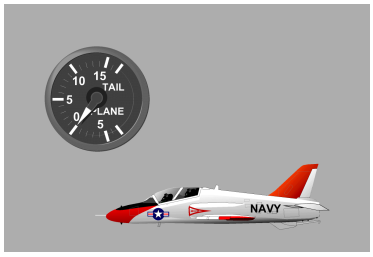
**CANOPY AND FLIGHT CONTROL EMERGENCY PROCEDURES**

* Speed brake failure
* **Trim malfunctions**
* Flap/slat malfunctions
* Control augmentation failure
* Canopy

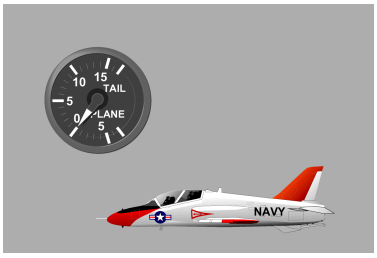
***Sg 2, fr 3, 4***
*Runaway Aileron Trim*



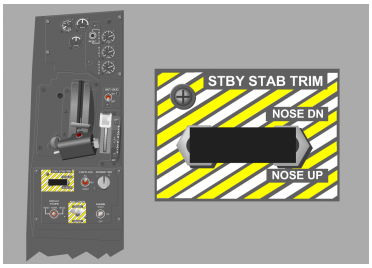

***Sg 2, fr 5, 6***
*Runaway Stabilator Trim--Up*



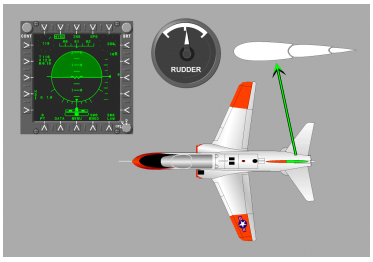

***Sg 2, fr 7, 8***
*Runaway Stabilator Trim--Down*



***Sg 2, fr 9***
*Standby Stabilator Trim*




***Sg 2, fr 10, 11***
*Runaway Rudder Trim*




b. Trim failure

(1) Stabilator position indicator needle fails to move with trim inputs

(2) Fails to respond to stabilator trim inputs

3. Rudder **1.8.1.6.1.1**

a. Runaway trim

(1) Rudder pedals fully deflected

(2) Uncommanded yaw (slip indicator off center)

(3) Yaw-induced roll

(4) Rudder trim position indicator left/right

b. Trim failure

(1) Fails to respond to trim inputs

(2) Rudder trim position indicator fails to move

B. Procedures - See NATOPS **1.5.4.7.2, 1.8.1.6.4.2, 1.8.1.6.5.2, 1.8.1.6.7.2, 1.8.1.6.1.2, 1.8.1.6.6.2**

NOTE: Changes in airspeed may be required to maintain control in a runaway trim condition. With the exception of runaway nosedown trim, reducing airspeed will provide improved controllability.

III. Rudder trim hardover **1.8.1.6.3.1**

NOTE: The rudder trim system is interconnected with the yaw damper, which is part of the control augmentation system. A malfunction of certain CONTR AUG system components (e.g., yaw damper controller or yaw damper actuator) could cause undesirable rudder inputs.

A. Indications - Same as runaway trim

B. Procedures - See NATOPS

**PROGRESS CHECK**

**Question 1 — 1.8.1.6.8.2**
**What airspeed should you maintain if your speed brakes fail to retract?**

ANSWER: Max range or max endurance as the situation dictates

IV. Flap/slat malfunctions

A. Flap position indicator failure **1.8.1.8.3.1**

1. Indications

a. Indicator light fails to come on/off when flaps change position

b. Indicator lights show different flap positions between cockpits

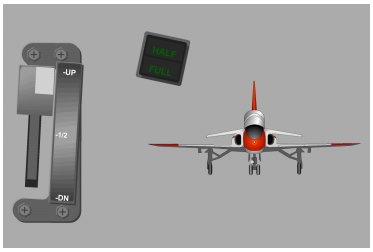
c. Visual confirmation of flap position

*Sg 3, fr 2*
*Lesson Organization*

**CANOPY AND FLIGHT CONTROL EMERGENCY PROCEDURES**

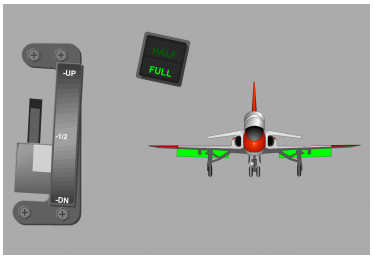
* Speed brake failure
* Trim malfunctions
* **Flap/slat malfunctions**
* Control augmentation failure
* Canopy

*Sg 3, fr 3-4, 5-6*
*Flap Indicator Failure*



***Sg 3, fr 7, 8***
*Split Flaps After Lowering*


***Sg 3, fr 9, 10***
*Split Flaps After Raising*




2. Procedures

   a. Confirm flap position visually, if possible

   b. Fly optimum AOA approach for flap/slat condition

B. Uncommanded roll/yaw **1.8.1.6.13.2**

1. Indications

   a. Aircraft rolls/yaws while lowering or raising flaps/slats

   b. Aircraft rolls/yaws while flaps/slats extended

   NOTE: The above indications probably indicate an asymmetrical wings flaps condition

2. Procedures - See NATOPS

**LESSON NOTE**

Split slats are an unlikely emergency in the T-45C. Explain that the indications will be the same as split flaps, and both follow the uncommanded roll/yaw procedure.

NOTE: You should expect more control problems with split flaps than split slats due to the fact that there will be a greater drag difference between the wings. In either case, a constant AOA/ airspeed approach to short field arrestment will minimize your controllability problems.

C. Flaps Failure (Flaps fail to extend) **1.8.1.6.11.1, 1.8.1.6.11.1.1**

1. Indications

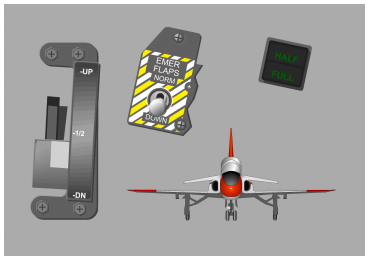
   a. Flap position indication does not change to correspond with flap handle position or emergency flap down selection

   b. No tactile indication of flaps extending

   c. Optimum AOA is increased

2. Procedures - See NATOPS

*Sg 3, fr 11*
*Flaps Fail to Extend*




D. Slats fail **1.8.1.6.15.1, 1.8.1.6.14.2**

1. Indications

   a. SLATS caution light illuminated

      NOTE: Slats are not in the selected position, or a split slat condition exists, or exceeding 217 knots with flaps/slats selected down.

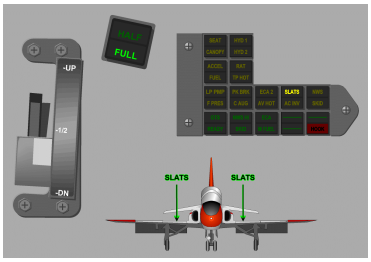
   b. Visual confirmation of slat position

   c. Aircraft rolls

   d. With split slats or slats up, abrupt roll off with no stall warning may occur at clean stall AOA (approximately 25 units)

2. Procedures - See NATOPS

*Sg 3, fr 12*
*Slats Fail to Extend*




**PROGRESS CHECK**

**Question 2 — 1.8.1.6.13.2**
**To what position should you set the FLAPS/SLATS lever if you have uncommanded roll/yaw?**

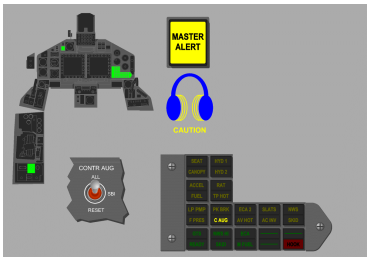
ANSWER: Return the FLAPS/SLATS lever to the previous setting.

*Sg 4, fr 2*
*Lesson Organization*

**CANOPY AND FLIGHT CONTROL EMERGENCY PROCEDURES**

* Speed brake failure
* Trim malfunctions
* Flap/slat malfunctions
* **Control augmentation failure**
* Canopy

*Sg 4, fr 3 (2 overlays)*
*Control Augmentation Failure*




*Overlay 1*

*Overlay 2*

*Sg 11, fr 2*
*Lesson Organization*

**CANOPY AND FLIGHT CONTROL EMERGENCY PROCEDURES**

* Speed brake failure
* Trim malfunctions
* Flap/slat malfunctions
* Control augmentation failure
* **Canopy**

V. Control augmentation system

A. C AUG failure **1.8.1.6.1.4**

1. Indications

a. C AUG caution light is ON

NOTE: C AUG caution light will illuminate whenever the switch is off, inputs from GINA are invalid, system has internal failure, system is in BIT.

b. Yaw damping, turn coordination, speed brake to stabilator interconnect (SBI), and rudder trim are inoperative

2. Procedures - See NATOPS

VI. Canopy

A. Unlocked **1.5.4.4.2**

? **If the canopy is unlocked, when will the MASTER ALERT flash and CANOPY caution light illuminate?**

ANSWER: Anytime the canopy is unlocked, the CANOPY caution light will be illuminated. The MASTER ALERT flashes and warning tone sounds when the canopy is still unlocked and the throttle position is advanced above 95%.

1. Indications

   a. Canopy caution light is on

   b. Canopy control lever will not engage safety catch

   c. UNLOCKED label not fully covered by thumb plate, or locked arrows do not line up

   d. MASTER ALERT light flashes, CANOPY caution light illuminates, and caution tone sounds when throttle position is above 95% $N_2$ rpm and the canopy is unlocked

   e. Lack of cabin pressurization above 5,000 ft MSL

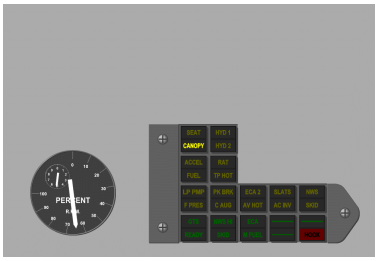
   f. Canopy external handle not in horizontal position

   g. Noise caused by air leak around seal

2. Procedures - See NATOPS

B. Lost canopy procedures - See NATOPS **1.8.1.10.7.2**

***Sg 11, fr 3, 4***
*Canopy Unlocked*




**PROGRESS CHECK**

**Question 3 — 1.5.4.4.2**
**You should stay below what airspeed if you have indications of an unlocked canopy?**

ANSWER: 200 KIAS

*Sg 10, fr 2*
*Review Menu*

## SUMMARY

This lesson has presented emergency procedures for the following situations:

* Speed brake failure
* Trim failure/runaway
* Flap/slat malfunctions
* Control augmentation failure
* Canopy unlocked/lost

## CONCLUSION

Unannounced aerobatic maneuvers can raise your pucker factor by several orders of magnitude. Knowing the correct procedures for countering control surface malfunctions will help reduce the pucker factor by at least one order of magnitude.

# HOMEWORK LESSON

**COURSE/STAGE:** TS, ADV & IUT / Emergency Flight Procedures

**LESSON TITLE:** Canopy and Flight Control Emergency Procedures

**LESSON IDENTIFIER:** T-45C TS, ADV & IUT EMFP-07

**FIGURES:** N/A

**STUDY RESOURCES:**

* T-45C NATOPS Flight Manual, A1-T45AC-NFM-000
* T-45C NATOPS Pilot's Pocket Checklist, A1-T45AC-NFM-500

**LESSON PREPARATION:**

Read:

* Emergency procedures concerning trim, flaps, and canopy in Chapter 15, "In-Flight Emergencies," and Chapter 16, "Landing Emergencies," in the T-45C NATOPS Flight Manual, A1-T45AC-NFM-000, and "Emergency Procedures" in the Pilot's Pocket Checklist, A1-T45AC-NFM-500

**REINFORCEMENT:** N/A

**EXAMINATION:** N/A

## MOTIVATION

This workbook gives you a quick look at flight control malfunctions and how to counter their effects. Test your common sense approach to handling them; then get the "school solution" from NATOPS. If you are not convinced, make notes and talk it over with your instructor when you meet for EMFP-09.

## OVERVIEW

The goals of this lesson are to familiarize you with some specific emergency procedures in NATOPS and to prepare you for the lecture in EMFP-09.

This lesson presents eight NATOPS research exercises for the following situations:

* Speed brake failure to retract
* Trim malfunctions
* Flap/slat malfunctions
* Control augmentation caution light
* Canopy unlocked/lost

## REFRESHER

Recall:

* The T-45C ailerons, stabilator, speed brakes, flaps, and slats are hydraulically operated
* The location and function of T-45C trim controls and indicators
* The T-45C warning panel and caution advisory panel lights associated with the canopy and flight control systems

## PRESENTATION

Procedural steps preceded by an asterisk (*) are "immediate action" items. You must be able to accomplish those steps without reference to the checklist.

### SPEED BRAKE FAILURE (FAILS TO RETRACT)

A speed brake that fails to retract is not a serious problem, unless a low fuel condition exists.

### PRACTICE EXERCISE 1

**You are solo and rendezvousing with lead, when you realize you're a little fast and will probably overshoot, so you extend the speed brakes to slow your rate of closure. As you retract the speed brakes, you notice airframe buffet and an illuminated SP BRK _____ light tells you that the speed brakes have not retracted completely.**

### PRACTICE EXERCISE 2

**Your wingman confirms that the speed brakes are not retracted. You should land as soon as _____.**

### TRIM MALFUNCTIONS

You can relatively easily overcome flight control problems caused by runaway trim or inoperative trim control by applying flight control forces to counteract the trim condition.

### PRACTICE EXERCISE 3

**In the event of a runaway trim condition, you will have to apply control _____ as required and, if possible, attempt to trim _____ _____ _____. For any trim failure or runaway, _____ airspeed. If it is stabilator-induced, use the STBY stabilator trim switch _____ _____ and vary airspeed as necessary.**

## FLAPS

### Flaps Asymmetry (Split Flaps) or Slats Asymmetry (Split Slats)

Since a single actuator controls the flaps in the T-45C, a hydraulic failure can't cause split flaps. The most probable cause of split flaps would be a mechanical failure in the control rods/bellcranks that control the flaps. The slats have an independent actuator for each wing, but each slat drive actuator is kept hydraulically symmetrical by a synchro cable that limits the possibility of split slats.

### PRACTICE EXERCISE 4

**You have just rolled wings level from the break at NAS Jacksonville. After you select 1/2 flaps, the aircraft rolls sharply to the right. Immediately, you counter roll and yaw with _____ and _____, set the FLAP/SLATS switch to the _____ position, and perform a _____ check. Landing should be accomplished as soon as _____.**

### Flaps/Slats Failing to Extend

Failure of the flaps/slats to extend may be caused by the same difficulties associated with Failure to Retract. In addition, low HYD-1 pressure can be a cause.

### PRACTICE EXERCISE 5

**Out of the break at NAS Gulf Coast, you set the FLAP/SLATS switch to DOWN, but the flap position indicator fails to move from the UP position, and the SLATS caution light illuminates.**
**In addition, buffeting and wind noise associated with flap/slat extension do not occur. If your attempt to lower the flaps with the emergency flap switch fails, you should fly _____ _____ and a _____ _____ pattern and prepare for a no flap/slat landing. Your airspeed will be _____ KIAS above the normal full flap/slat approach speed.**

**CONTROL AUGMENTATION**

**C AUG caution light**

May be caused by system being turned OFF, internal failure, invalid inputs, system in IBIT.

**PRACTICE EXERCISE 6**

**While flying straight and level, the MASTER ALERT light flashes and the C AUG caution light illuminates. You press and release the _____ switch, reset and release the _____ _____ switch and wait _____ seconds. The C AUG caution light goes out so you verify that the GINA is not _____ and place the C AUG switch to _____.**

**CANOPY**

**Unlocked**

The T-45 canopy latch mechanism is designed so that once locked, barring mechanical failure, it should not become accidentally unlocked in flight.

**PRACTICE EXERCISE 7**

**If the canopy becomes unlocked in flight, you should check that the *_____ _____ _____ is _____. If the canopy will not lock, reduce speed to below _____ KIAS, descend to below _____ ft MSL, place the air flow knob to _____, _____ the seat, place your visor in the _____ position and stow loose gear in the cockpit.**

**Lost Canopy Procedures**

A lost canopy at FL300 will be a real attention getter! A departing canopy can cause major damage to the empennage or other portions of the aircraft.

NOTE: Severe wind blast will accompany a lost canopy.

**PRACTICE EXERCISE 8**

**You are practicing ACM maneuvers, when suddenly your cabin depressurizes. You notice a gap between the canopy and rail. Before you can take any action, the canopy is torn off! You reduce airspeed and descend to below _____ ft, _____seat, and perform a _____ check while en route to land as soon as _____.**

## SUMMARY

This lesson has presented eight NATOPS research exercises for the following situations:

* Speed brake failure to retract
* Trim malfunctions
* Flap/slat malfunctions
* Control augmentation caution light
* Canopy unlocked/lost

## CONCLUSION

A lost canopy and associated wind blast, as well as split flaps and the associated rolling moment, are emergencies that will require your immediate attention. You should be extremely familiar with critical procedures contained in this lesson.

## ANSWER KEY

1. advisory
2. practical
3. force, from both cockpits, reduce, as required
4. stick, rudder, previous, controllability, practical
5. on-speed AOA, slightly wider, 42 to 49
6. paddle, C AUG, nine, degraded, ALL
7. canopy control lever, locked, 200, 25,000, OFF, lower, down
8. 10,000, lower, controllability, possible

# LECTURE GUIDE

**COURSE/STAGE:** TS, ADV & IUT / Emergency Flight Procedures

**LESSON TITLE:** Electrical and Indicator Emergency Procedures

**LESSON IDENTIFIER:** T-45C TS, ADV & IUT EMFP-08

**LEARNING ENVIRONMENT:** Classroom

**ALLOTTED LESSON TIME:** 1.7 hr

**STUDY RESOURCES:**

* T-45C NATOPS Flight Manual, A1-T45AC-NFM-000
* T-45C NATOPS Pilot's Pocket Checklist, A1-T45AC-NFM-500
* Lesson Guides for Engineering, "Electrical System Malfunctions," and Engineering, "Flight Instruments Malfunctions"

**(9-98) ORIGINAL**

**LESSON PREPARATION:**

Read:

* Emergency procedures concerning the electrical, air conditioning, pressurization, and OBOG systems in Part V, “Emergency Procedures,” of the T-45C NATOPS Flight Manual, A1-T45AC-NFM-000
* Associated procedures in “Emergency Procedures,” in the Pilot’s Pocket Checklist, A1-T45AC-NFM-500

Review:

* Lesson Guide, (Eng), “Electrical System Malfunctions”
* Lesson Guide, (Eng), “Flight Instruments Malfunctions”
* Lesson Guide, (Eng), "Display System and Malfunctions"

**REINFORCEMENT:** N/A

**EXAMINATION:**

The objectives in this lesson will be tested in EMFP 11X.

## LESSON OBJECTIVES

**1.8.1.3.3.2**
Recall procedures for generator failure

**1.8.1.3.1.1.2**
Recall procedures for generator failure with battery low voltage

**1.8.1.3.1.2.2**
Recall procedures for single inverter failure

**1.8.1.3.1.3.2**
Recall procedures for double inverter failure

**1.8.1.3.1.4.1**
Identify indications of total electrical failure

**1.8.1.3.1.4.2**
Recall procedures for total electrical failure

**1.8.1.3.5.2**
Recall procedures for cockpit lighting failure

**1.8.1.3.1.5**
Recall procedures for electrical fire

**1.8.1.7.3.2**
Recall procedures for pitot static malfunction

**1.8.1.4.4.2**
Recall procedures for smoke/fumes in cockpit

**1.8.1.4.1.2**
Recall procedures for cockpit air conditioning failure

**1.8.1.4.2.2**
Recall procedures for cabin pressurization failure

**1.8.1.4.3.2**
Recall procedures for OBOGS malfunction

**1.8.1.8.1.2**
Recall procedures for warning/caution audio failure (ON)

**1.8.1.8.1.2.1**
Recall reasons for procedures for centralized warning system audio tone failure—warning/caution light ON

**1.8.1.8.2.1**
Recall indications of warning/caution/advisory light failure

**1.8.1.8.2.2**
Recall procedures for warning/caution/advisory light failure

**1.8.1.8.2.2.1**
Recall reasons for procedures for warning/caution/advisory light failure

**2.8.2.1**
Identify indications for multi-function display (MFD) failure

**2.8.2.1.1**
Recall procedures for multi-function display (MFD) failure

## MOTIVATION

Assessing the cause and extent of jet aircraft electrical problems normally requires a strong electronics background, schematics, and some uninterrupted thought time. If you're not an engineer and you happen to be motoring around the sky, a basic system and checklist understanding and an as-soon-as-possible landing are probably the best alternatives.

## OVERVIEW

The goal of this lesson is to prepare you to correctly apply procedures that lead to safe recovery should you confront malfunctions in the following systems:

* Electrical system
* Pitot static
* ECS
* OBOGS
* Centralized warning system (CWS)
* Multi-function displays (MFDs)

## REFRESHER

Recall the:

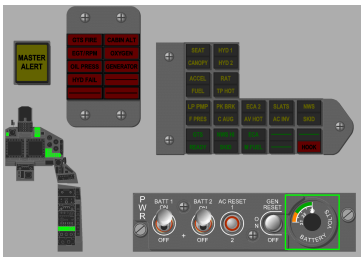
* Location and function of T-45C cockpit electrical, air conditioning, pressurization, and OBOGS controls
* Operating characteristics of the T-45C centralized warning system
* Operating characteristics of the T-45C Multi-Function Display

*Sg 1, fr 2*
*Lesson Organization*

**ELECTRICAL AND INDICATOR EMERGENCY PROCEDURES**

* Electrical system failures
* Pitot static malfunctions
* ECS failures
* OBOGS contamination/failure
* CWS failure
* MFD failure

*Sg 1, fr 3, 4*
*Generator Failure*




## PRESENTATION

NOTE: Procedural steps preceded by an asterisk (*) are considered immediate action items. You must be able to accomplish these steps without reference to the checklist.

I. Electrical system failures

A. DC

1. Generator failure **1.8.1.3.3.2**

a. Indications

(1) MASTER ALERT light flashes and appropriate tones sound

(2) GENERATOR warning light illuminates

(3) F PRES caution light illuminates (30 seconds after loss of generator)

(4) AC INV caution light will illuminate when AC inverter No. 2 is tripped off

(a) On aircraft 165456 and below without AFC 199

(i) Activates relay disabling one inverter illuminating AC INV caution light

(ii) Activates relay disconnecting non-essential AC bus

(b) On aircraft 165457 and up and on aircraft 165456 and below with AFC 199 incorporated

(i) Both inverters remain on-line and AC INV caution does not illuminate

(ii) Activates relay disconnecting non-essential AC bus

(5) C AUG caution light illuminates (airspeed less than 217 knots)

(6) Voltmeter reads 24 volts or less

(7) Loss of nonessential services

(8) Loss of RH MFD both cockpits

(9) LH MFD both cockpits revert to ADI display

b. Procedures - See NATOPS

2. Generator failure with low battery voltage **1.8.1.3.1.1.2**

NOTE: With the generator off-line, the voltmeter indicates battery voltage to the 28 VDC essential services bus. Voltage of less than 24 volts may prevent a generator reset.

**LESSON NOTES**

*Emphasize the difference between indications of generator failure and of generator failure with battery low voltage.*

a. Indications

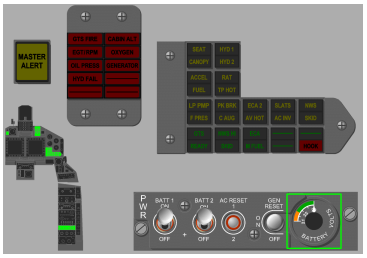
(1) MASTER ALERT light flashes and appropriate tones sound

(2) GENERATOR warning light illuminates

(3) F PRES caution light illuminates (30 seconds after loss of generator)

(4) C AUG caution light illuminates (airspeed less than 217 knots)

***Sg 1, fr 5, 6***
*Generator Failure with Low Battery Voltage*



(5) AC INV caution light will illuminate when AC inverter No. 2 is tripped off

(a) On aircraft 165456 and below without AFC 199

(i) Activates relay disabling one inverter illuminating AC INV caution light

(ii) Activates relay disconnecting non-essential AC bus

(b) On aircraft 165457 and up and on aircraft 165456 and below with AFC 199 incorporated

(i) Both inverters remain on-line and AC INV caution does not illuminate

(ii) Activates relay disconnecting non-essential AC bus

(6) Voltmeter reads less than 24 volts

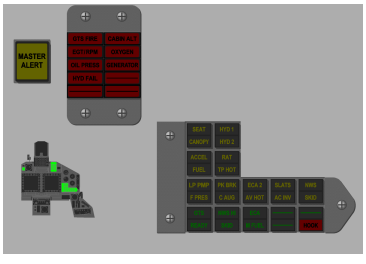
(7) Loss of nonessential services

(8) Loss of RH MFD both cockpits

(9) LH MFD both cockpits revert to ADI display

b. Procedures: comply with generator failure procedures

***Sg 1, fr 7, 8***
*Single/Double Inverter Failure*




B. AC

1. Single inverter failure **1.8.1.3.1.2.2**

a. Indications

(1) MASTER ALERT light flashes and caution tone sounds

(2) AC INV caution light illuminates

(3) Loss of all nonessential AC equipment

b. Procedures - See NATOPS

2. Double inverter failure **1.8.1.3.1.3.2**

a. Indications

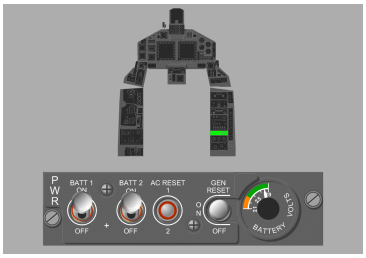
(1) MASTER ALERT light flashes and caution tone sounds

(2) AC INV caution light illuminates

(3) Loss of all AC equipment

b. Procedures: comply with AC inverter failure procedures

***Sg 1, fr 9***
*AC Reset Switch*




**LESSON NOTES**

*Give an example of what could happen if the reset switch is held in place.*

C. Total electrical failure **1.8.1.3.1.4.1, 1.8.1.3.1.4.2**

1. Indications

a. All electrically controlled flight instruments cease to function

b. Loss of all aircraft lights (internal and external)

c. Loss of flaps/slats, stabilator trim, rudder trim, yaw damper, and aileron trim

d. Loss of communication systems and navigation systems

***Sg 1, fr 10***
*Cockpit Lighting Failure*

2. Procedures - See NATOPS

D. Cockpit lighting failure **1.8.1.3.5.2**

1. Indications: fails to illuminate when selected ON

2. Procedures

a. Maintain control using outside visual references

b. Emergency flood lighting automatically activated

c. Illuminate cockpit using flashlight

d. Check for flags on standby instruments

e. Dimmer controls - FULLY CLOCKWISE

f. Check BATT switches - ON

g. **If unable to restore lighting**

(1) Verify malfunction is related to electrical system

(2) Land as soon as practical

E. Electrical fire **1.8.1.3.1.5**

1. Indications

a. Smoke or acrid odors

b. Associated system fails when circuit breaker pops

c. Fluctuating instrument readings

d. Flickering lights

2. Procedures - See NATOPS

**PROGRESS CHECK**

**Question 1 — 1.8.1.3.1.2.2**
**The AC INV caution light has illuminated and you are unable to extinguish it by resetting AC 1 and 2. What should be your next procedure?**

ANSWER:
1. Maintain VMC
2. Land as soon as practical

**Question 2 — 1.8.1.3.1.4.2**
**How should you lower the landing gear as you prepare to land with total electrical failure?**

ANSWER: EMERG GEAR HANDLE - PULL

**Question 3 — 1.8.1.3.1.4.2**
**How should you handle the throttle in the event of a total electrical failure?**

ANSWER: Move the throttle carefully because the ECA is inoperative.

*Sg 3, fr 2*
*Lesson Organization*

**ELECTRICAL AND INDICATOR EMERGENCY PROCEDURES**

* Electrical system failures
* Pitot static malfunctions
* ECS failures
* OBOGS contamination/failure
* CWS failure
* MFD failure

*Sg 3, fr 3-4*
*Pitot Static System Failure*

II. Pitot static malfunctions **1.8.1.7.3.2**

A. Indications

1. Standby altimeter needle freezes or reads erroneously

2. Approach airspeed/AOA cross-check: AOA does not correspond to computed IAS

3. Standby VSI freezes or fluctuates (appears unreliable)

4. Standby airspeed indicator moves erratically or is inoperative

5. If below 5000 ft AGL, radar altimeter readout plus known terrain elevation disagrees with barometric altimeter

B. Procedures - See NATOPS

**PROGRESS CHECK**

**Question 4 — 1.8.1.7.3.2**
**What should you use to replace a malfunctioning Mach/ airspeed indicator during climb, cruise, descent, and approach?**

ANSWER: AOA

***Sg 5, fr 2***
*Lesson Organization*

**ELECTRICAL AND INDICATOR EMERGENCY PROCEDURES**

* Electrical system failures
* Pitot static malfunctions
* ECS failures
* OBOGS contamination/failure
* CWS failure
* MFD failure

***Sg 5, fr 3, 4***
*Smoke and Fumes in Cockpit*

III. ECS failures

A. Smoke/fumes/fog in cockpit **1.8.1.4.4.2**

1. Indications

*NOTE: Consider all unidentified fumes in the cockpit as toxic. Do not confuse condensation from the air conditioning system with smoke. A possible source of visible smoke or fumes in the cockpit is from the engine bleed or residual oil in the air conditioning ducts. This smoke is blue-gray in color, has a characteristic oily odor, and may cause the eyes to sting. Another source of smoke or fumes is an electrical malfunction or overheat of the equipment located in the cockpit. In the event of an electrical short or overload condition, this equipment may generate acrid smoke (usually white or gray color).*

a. Visible smoke

b. Fumes

c. Sting in your eyes

2. Procedures - See NATOPS

B. Cockpit air conditioning failure or cockpit pressurization failure **1.8.1.4.1.2, 1.8.1.4.2.2**

1. Indications

a. MASTER ALERT light flashes and warning tone sounds

b. CABIN ALT warning light illuminates

c. Inability to control cockpit temperature

d. Cabin altitude exceeds 25,500 +/- 500 ft

e. Discomfort in ears and sinuses as altitude increases

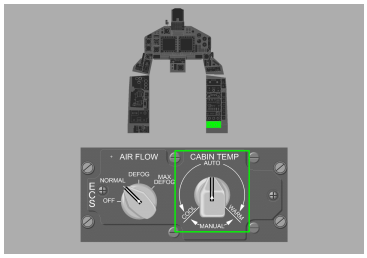
2. Procedures - See NATOPS

C. Cabin temperature failure

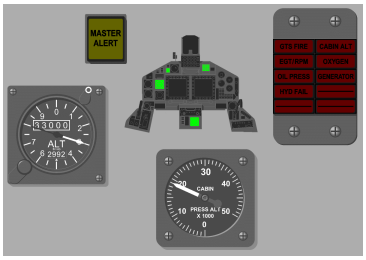
1. *CABIN TEMP control knob - MANUAL, ADJUST TEMP*

*NOTE: If cockpit temperature is extreme and not controllable, consider pulling the MDC handle after reducing altitude and airspeed.*

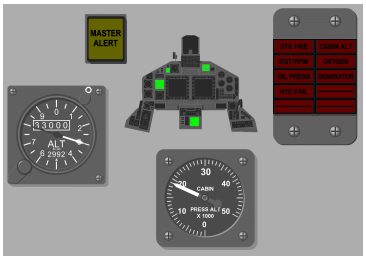
***Sg 5, fr 5***
*Cockpit Air Conditioning Knob*




***Sg 5, fr 6, 7***
*Air Conditioning Failure*




***Sg 5, fr 8, 9***
*Cockpit Pressurization Failure*




**PROGRESS CHECK**

**Question 5 — 1.8.1.7.3.2**
**Which instruments should you cross-check if you suspect pitot icing?**

ANSWER: Standby airspeed, standby altimeter, and standby VSI

**PROGRESS CHECK**

**Question 6 — 1.8.1.4.1.2**
**Below what altitude should you descend if you cannot correct an air conditioning malfunction?**

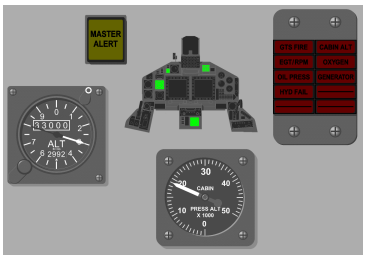
ANSWER: 25,000 ft MSL

*Sg 6, fr 2*
*Lesson Organization*

**ELECTRICAL AND INDICATOR EMERGENCY PROCEDURES**

* Electrical system failures
* Pitot static malfunctions
* ECS failures
* OBOGS contamination failure
* CWS failure
* MFD failure

*Sg 6, fr 3, 4*
*Contamination/ Failure of OBOGS*




## IV. OBOGS contamination **1.8.1.4.3.2**

### A. Indications

NOTE: OBOGS over temp or low oxygen concentration is indicated by the illumination of the OXYGEN warning light, a noticeable problem breathing, or hypoxia. The failure may be high temperature bleed air leak, a heat exchanger failure, or insufficient oxygen concentration. Also, a Solid State Oxygen Monitor (SSOM) will illuminate the OXYGEN warning light if an oxygen monitor fault is detected.

1. MASTER ALERT light flashes and warning tone sounds

2. OXYGEN warning light illuminates

3. Irritants detected in breathing oxygen from OBOGS

B. Procedures - See NATOPS

**PROGRESS CHECK**

**Question 7 — 1.8.1.4.3.2**
**Below what altitude should you descend if you have an OBOGS malfunction?**

ANSWER: 10,000 ft cabin altitude or minimum safe altitude

V. Centralized warning system (CWS) failure

A. Audio tone failure **1.8.1.8.1.2, 1.8.1.8.1.2.1**

1. Indications: confirmed malfunction causes warning/ caution lights to illuminate without tone

2. Procedures

a. Comply with procedures for indicated malfunction

b. Set MASTER TEST switch to TONE TEST to test audio tone

c. Verify operation of intercom normal amplifier (NORM)

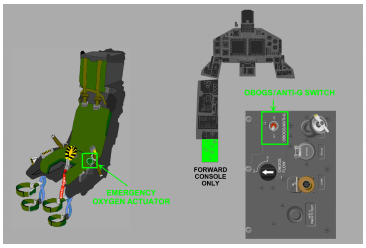
(1) Perform comm check with aft cockpit or key ICS and listen for side tone

(2) Select alternate amplifier (ALT)

NOTE: If tone sounds for no apparent reason, attempt to cancel by pushing the MASTER ALERT light.

d. Land as soon as practical

***Sg 6, fr 5***
*Emergency Oxygen Actuator/OBOGS/ Anti-g*

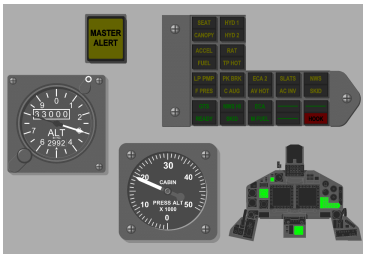



***Sg 8, fr 2***
*Lesson Organization*

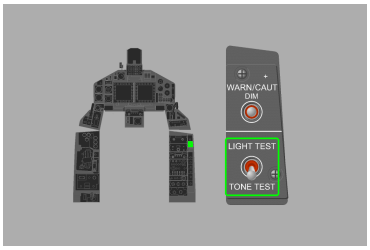
**ELECTRICAL AND INDICATOR EMERGENCY PROCEDURES**

* Electrical system failures
* Pitot static malfunctions
* ECS failures
* OBOGS contamination/failure
* CWS failure
* MFD failure

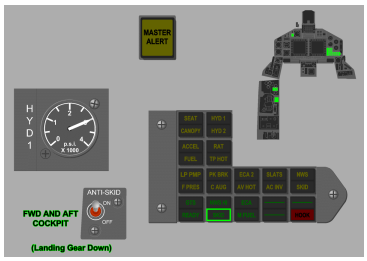
***Sg 8, fr 3, 4***
*Warning/Caution Tone Failure*




***Sg 8, fr 5***
*Light Test/Tone Test Switch*



***Sg 8, fr 6, 7***
*CWS Light Failure*




B. CWS light failure **1.8.1.8.2.1, 1.8.1.8.2.2, 1.8.1.8.2.2.1**

1. Indications

   a. Confirmed malfunction causes warning/caution tone

   b. No associated warning or caution light illuminated

      NOTE: The CWS and advisory annunciator lights are automatically dimmed when the center panel lights are turned on. Certain lighting conditions may require that the center panel lights be turned off in order to see the warning, caution, or advisory lights.

   c. Fails to test properly using MASTER TEST switch

2. Procedures

   a. Select MASTER TEST switch to LIGHT TEST

   b. Note WARNING or CAUTION light not illuminated

   c. Check associated system instruments for system failure indications

   d. Initiate appropriate system failure or emergency procedure

   e. Until on deck, if appropriate, continue to regularly monitor associated system instruments for a worsening situation

**PROGRESS CHECK**

**Question 8 — 1.8.1.8.1.2**
**How can you identify a failed WARNING/CAUTION light?**

ANSWER: Select MASTER TEST switch to LIGHT TEST.

VI. Multi-Function Display (MFD) failure

A. MFD

1. MFD failure

a. Indications

(1) Blank screen

(2) Blinking screen

(3) Stuck button(s)

(4) Multiple anomalies

b. Procedures

(1) Check position of OFF/D/N, BRT, and CONT knobs for correct setting for light conditions

(2) Cycle OFF/D/N knob and if problem is still there, turn affected MFD off

(3) Select BIT page to check equipment status

(4) Set display power switch to RESET

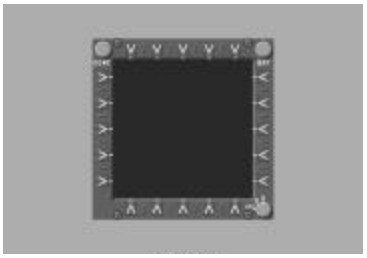
(5) Set display power switch to ORIDE for generator power loss to power LH MFD from 28 VDC essential bus

***Sg 9, fr 2***
*Lesson Organization*

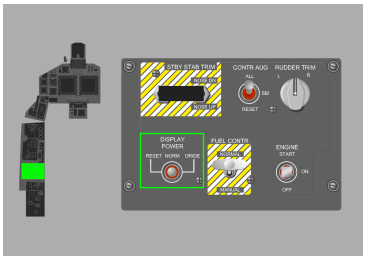
**ELECTRICAL AND INDICATOR EMERGENCY PROCEDURES**

* Electrical system failures
* Pitot static malfunctions
* ECS failures
* OBOGS contamination/failure
* CWS failure
* MFD failure

***Sg 9, fr 3***
*MFD Failure*



***Sg 9, fr 4***
*Display Power Switch*



***Sg 10, fr 2***
*Review Menu*

## SUMMARY

This lesson has presented emergency procedures for in-flight malfunctions in the following:

* Electrical system
* Instruments
* ECS
* OBOGS
* Centralized warning system (CWS)
* MFD

## CONCLUSION

If this lesson has raised any questions for you, be certain to contact your instructor.

# LESSON GUIDE

**COURSE/STAGE:** TS, ADV & IUT / Emergency Flight Procedures

**LESSON TITLE:** Electrical and Indicator Emergency Procedures

**LESSON IDENTIFIER:** T-45C TS, ADV & IUT EMFP-09

**LEARNING ENVIRONMENT:** CAI

**ALLOTTED LESSON TIME:** 1.5 hr

**STUDY RESOURCES:**

* T-45C NATOPS Flight Manual, A1-T45AC-NFM-000
* T-45C NATOPS Pilot's Pocket Checklist, A1-T45AC-NFM-500
* Emergency Flight Procedures-10, Electrical and Indicator Emergency Procedures

**(9-98) ORIGINAL**

**LESSON PREPARATION:**

Read:

* Emergency procedures concerning the electrical, air conditioning, pressurization, and OBOG systems in Part V, “Emergency Procedures,” in the T-45C NATOPS Flight Manual, A1-T45AC-NFM-000 and "Emergency Procedures,” in the T-45C NATOPS Pilot's Pocket Checklist, A1-T45AC-NFM-500

Review

* Lesson Guide, EMFP-7, "Electrical and Indicator Emergency Procedures"
* Lesson Guide, ENG-03, "Electrical System Malfunctions"
* Lesson Guide, ENG-18, "OBOGS and ECS/Pressurization Malfunctions"
* Lesson Guide, ENG-20, "Flight Instrument Malfunctions"

**REINFORCEMENT:** N/A

## LESSON OBJECTIVES

**1.8.1.3.1.2.2**
Recall procedures for single inverter failure

**1.8.1.3.1.3.2**
Recall procedures for double inverter failure

**1.8.1.3.1.4.2**
Recall procedures for total electrical failure

**1.8.1.3.1.5**
Recall procedures for electrical fire

**1.8.1.7.3.2**
Recall procedures for pitot static malfunctions

**1.8.1.4.4.2**
Recall procedures for smoke/fumes in cockpit

**1.8.1.4.1.2**
Recall procedures for cockpit air conditioning failure

**1.8.1.4.2.2**
Recall procedures for cabin pressurization failure

**1.8.1.4.3.2**
Recall procedures for OBOGS malfunction

## MOTIVATION

Electrical, environmental, or indicator emergencies can be subtle such as erroneous airspeed indications due to pitot static system malfunctions or smoke in the cockpit that is not very subtle. Use these exercises to solidify what you learned in EMFP-08. If there is something that still does not make sense, now is the time to get it straightened-out.

## OVERVIEW

This lesson provides NATOPS exercises for emergency procedures for:

- Single Inverter Failure
- Double Inverter Failure
- Total Electrical Failure
- Electrical Fire
- Pitot Static Malfunction
- Smoke/fumes in Cockpit
- Cockpit Air Conditioning and Cabin Pressurization Failure
- OBOGS Malfunction

This lesson is presented in three basic phases:

Instruction Phase

The student will be guided “hands-on” through the emergency procedure with audio and on-screen text prompts. Completion of the instruction for the procedure qualifies the student to select that specific procedure from the Practice menu.

Practice Phase

The student may select any of the emergency procedures for which he/she has completed the instruction phase of training. The Practice session will identify the procedure being practiced in the header at the top of the screen, but will not tell the student which step to perform or how to perform it. Practice sessions demand proper action in the proper sequence. Feedback is given and the opportunity to attempt the procedure again if an error is made. If desired, the student may retake an instructional section.

Random Practice

Once all the Practice Phase elements have been successfully completed, the student may elect to have the computer select emergency situations at random for practice.

There are three major differences between the Practice Phase and the Random Practice Phase.

1. In the Practice Phase, the emergency procedure is identified in the header at the top of the screen. In Random Practice the emergency is not identified.

2. At the completion of the Random Practice or when a step is incorrect, the lesson will ask you to identify which emergency procedure you are attempting.

3. Random Practice is not a lesson completion requirement. It is an opportunity for you to test yourself at a higher level. It is also an excellent means to review for a check flight when the simulator is not available.

The goal of this lesson is to prepare you to correctly apply procedures that lead to safe recovery should you confront malfunctions in the following systems:

* Electrical system
* Instruments
* ECS
* OBOGS
* Centralized warning system (CWS)

## REFRESHER

Recall the electrical, environmental and indicator emergency procedures you learned during EMFP-10.

## PRESENTATION

I. Single Inverter Failure **1.8.1.3.1.2.2**

A. Indications

1. MASTER ALERT flashes
2. Caution tone sounds
3. AC INV caution light illuminates
4. VOR/ILS/Marker Beacon receiver and Radar Altimeter lost

B. Procedures - Refer to Part V, Chapter 12, General Emergencies, of the T-45C NATOPS

II. Double Inverter Failure **1.8.1.3.1.3.2**

A. Indications

1. MASTER ALERT flashes
2. Caution tone sounds
3. AC INV caution light illuminates
4. VOR/ILS/Marker Beacon receiver and Radar Altimeter lost.
5. C AUG caution light illuminates below 217 knots.

B. Procedures - Refer to Part V, Chapter 12, General Emergencies, of the T-45C NATOPS

III. Total Electrical Failure **1.8.1.3.1.4.2**

A. Indications

1. All electrical communication, navigation and indicators inoperative

2. OBOGS heater and concentrator inoperative

B. Procedures - Refer to Part V, Chapter 15, In-Flight Emergencies, of the T-45C NATOPS

IV. Electrical Fire **1.8.1.3.1.5**

A. Indications (possible)

1. Smoke and acrid odors

2. Associated system fails when circuit breaker pops

3. Fluctuating instrument readings

4. Flickering lights

B. Procedures - Refer to Part V, Chapter 15, In-Flight Emergencies, of the T-45C NATOPS

V. Pitot Static Malfunctions **1.8.1.7.3.2**

A. Indications (possible)

1. Barometric altimeter freezes or reads erroneously

2. Approach airspeed and angle of attack do not agree

3. VSI freezes or fluctuates

4. Airspeed indications blanked or erratic

B. Procedures - Refer to Part V, Chapter 15, In-Flight Emergencies, of the T-45C NATOPS

VI. Smoke/Fumes in Cockpit **1.8.1.4.4.2**

A. Indications

1. Smoke in the cockpit

a. Unidentified fumes

Note: Consider all unidentified fumes in the cockpit as toxic

Don't confuse condensation from the air-conditioning system with smoke

b. Blue gray smoke associated with an oily odor is normally engine oil in the air conditioning ducts.

c. White or gray smoke may be from an electrical malfunction or overheated equipment in the cockpit.

B. Procedures - Refer to Part V, Chapter 15, In-Flight Emergencies, of the T-45C NATOPS

VII. Cockpit Air Conditioning Failure and Cabin Pressurization failure **1.8.1.4.1.2, 1.8.1.4.2.2**

A. Indications

1. MASTER ALERT flashes

2. Warning tone sounds

3. CABIN ALT warning light illuminates indicates either an air conditioning or a cabin pressurization failure.

a. If cabin pressure altimeter is less than 24,500 +/- 500 feet, it is an air conditioning malfunction.

b. If the cabin pressure altimeter is more than 24,500 +/- 500 feet, it is a cabin pressurization failure.

B. Procedures - Refer to Part V, Chapter 12, General Emergencies, of the T-45C NATOPS.

VIII. OBOGS Malfunction **1.8.1.4.3.2**

A. Indications

1. MASTER ALERT flashes

2. Warning tone sounds

3. OXYGEN warning light illuminates

4. May have a noticeable problem breathing or experience hypoxia.

NOTE: The OXYGEN warning light also comes on when the OBOGS/ANTI-G switch is turned OFF.

B. Procedures - Refer to parts V, Chapter 12, General Emergences, of the T-45C NATOPS.

## SUMMARY

This lesson provided NATOPS exercises for emergency procedures for:

Single and Double Inverter Failure
Total Electrical Failure
Electrical Fire
Pitot Static Malfunction
Smoke/fumes in Cockpit
Cockpit Air Conditioning and Cabin Pressurization Failure
OBOGS Malfunction

## CONCLUSION

You should finish this lesson with the ability to recognize system malfunctions and to make safe logical decisions about how to deal with them. You'll have many opportunities in the simulator to practice coping with the emergencies discussed in this lesson. You cannot practice them too much. The safe completion of some future mission may depend on your ability to correctly evaluate a malfunction and act accordingly.

# LECTURE GUIDE

**COURSE/STAGE:** TS, ADV & IUT / Emergency Flight Procedures

**LESSON TITLE:** Operational and Landing Emergency Procedures

**LESSON IDENTIFIER:** T-45C TS, ADV & IUT EMFP-10

**LEARNING ENVIRONMENT:** Classroom

**ALLOTTED LESSON TIME:** 1.5 hr

TRAINING AIDS:

* Figures
  - Fig 1: Precautionary Approaches
  - Fig 2: Precautionary Approaches

**STUDY RESOURCES:**

* T-45C NATOPS Flight Manual, A1-T454AC-NFM-000
* T-45C NATOPS Pilot's Pocket Checklist, A1-T45AC-NFM-500

**LESSON PREPARATION:**

Complete:

* EMFP-12 workbook lesson, “Operational and Landing Emergency Procedures”

Review:

* T-45C NATOPS Flight Manual, A1-T45AC-NFM-000
  - “Landing Gear System” and “Arresting Hook System” sections in Part I, Chapter 2, “System Descriptions”
  - Part V, Chapter 12, “General Emergencies”
  - Part V, Chapter 14, “Takeoff Emergencies”
  - Part V, Chapter 15, “In-Flight Emergencies”
  - Part V, Chapter 16, “Landing Emergencies”
* Associated procedures in “Emergency Procedures” in the Pilot's Pocket Checklist, A1-T45AC-NFM-500

**REINFORCEMENT:** N/A

**EXAMINATION:**

The objectives in this lesson will be tested in EMFP 11X.

## LESSON OBJECTIVES

**1.9.3.2.1.1**
Recall indications of landing gear unsafe/fails to extend

**1.9.3.2.2**
Recall procedures for landing gear unsafe/fails to extend

**1.5.4.6.1.1**
Recall indications of gear door malfunctions

**1.5.4.6.2**
Recall procedures for gear door malfunctions

**1.9.3.5.1.1**
Recall indications of landing gear door malfunctions after lowering

**1.9.3.5.2**
Recall procedures for landing gear door malfunctions after lowering

**1.8.1.8.4.2**
Recall procedures for landing gear indicator failure

**1.5.1.4.3.3**
Recall procedures for landing with wheel brake failure

**1.5.1.4.3.4**
Recall procedures for wheel brake failure after touchdown

**1.9.3.10.6**
Recall procedures for swerve after touchdown

**1.9.3.11.1**
Recall procedures for landing with blown tire

**1.9.3.11.2**
Recall procedures for blown tire on landing

**1.5.1.4.2.3**
Recall procedures for NWS caution light airborne

**1.5.1.4.2.4**
Recall procedures for landing with NWS caution light illuminated

**1.9.2.16.2.2**
Recall procedures and techniques for short-field arrested landing

**1.9.2.16.1.2**
Recall procedures and techniques for long-field arrested landing

**1.9.2.16.1.1.1**
Recall situations requiring long-field arrested landings

**1.9.3.12.2**
Recall procedures for launch bar malfunction

**1.9.3.15.1**
Identify indications of tail hook malfunctions in the landing phase

**1.9.3.15.2**
Recall procedures for tail hook malfunctions in the landing phase

**1.9.3.9.2**
Recall procedures for anti-skid failure

## MOTIVATION

Few aviators are defeated by an isolated emergency at cruising altitude. It's when problems start ganging up and most of your altitude is above you, that separate the pros from the statistics.

## OVERVIEW

In this lesson, you will learn the emergency procedures for malfunctions related to the landing gear, wheel brakes, the launch bar, the tail hook, and the anti-skid systems. Keep in mind that although these malfunctions are presented separately, two or more of them could occur at once.

This lesson will increase your ability to make the proper decisions should you face one or more of these malfunctions.

This lesson presents emergency procedures for the following:

* Landing gear/gear door malfunctions
* Landing gear indicator failure
* Wheel brake failure
* Blown tire
* Nose wheel steering failure
* Arrested landings
* Launch bar malfunction
* Tail hook malfunction
* Anti-skid failure
* Precautionary approach
* Flameout approach

## REFRESHER

Recall the:

* Location and function of T-45C cockpit controls and indicators for the landing gear, launch bar, and tail hook
* Caution and warning indications associated with the landing gear, wheel brakes, launch bar, tail hook, anti-skid system

## PRESENTATION

NOTE: Procedural steps preceded by an asterisk (*) are considered immediate action items. You must be able to accomplish these steps without reference to the checklist.

*Sg 1, fr 2*
*Lesson Organization*

**OPERATIONAL AND LANDING EMERGENCY PROCEDURES**
* Landing gear/gear door malfunctions
* Landing gear indicator failure
* Wheel brake failure
* Blown tire
* Nose wheel steering failure
* Arrested landings

I. Landing gear/gear door malfunctions **1.9.3.2.1.1, 1.9.3.2.2, 1.5.4.6.1.1, 1.5.4.6.2, 1.9.3.5.1.1, 1.9.3.5.2**

A. Landing gear unsafe/fails to extend

1. Indications

a. With LDG GEAR handle not set to DN, the WHEELS warning light will flash and a warning tone will sound if the throttle position is less than 95% $N_2$ position and either of the following conditions exist:

(1) Altitude is 7,200 ft MSL or less and the airspeed is less than 170 kts (less than 9,500 $\pm$ 300 ft MSL when climbing or 7,700 $\pm$ 500 ft MSL when descending)

or

(2) The FLAPS/SLATS lever is not set to UP

NOTE: Push the TONE button to cancel the tone; the wheels warning light will then

illuminate steady. The wheels warning light will not flash due to an unsafe gear indication when the landing gear handle is in the down position. The only indications of an unsafe gear situation are as follows:

b. Landing gear handle warning light remains illuminated

c. One or more landing gear lights (NOSE, LEFT, RIGHT) not illuminated

NOTE: The NOSE, LEFT, and RIGHT gear lights illuminate when gear are down and locked.

d. LDG GEAR DOOR light remains illuminated

e. Abnormal sounds and feel of gear extension

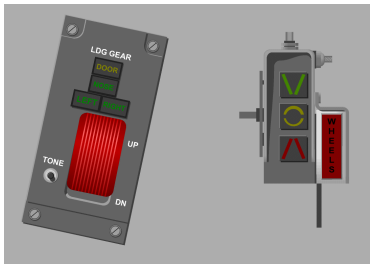
f. With only one main down, wind noise or drag from landing gear/gear doors may be apparent, and yaw may occur

g. Obtain visual check if available

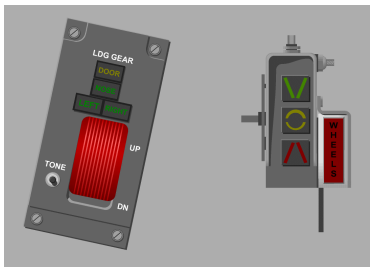
NOTE: The lack of AOA indexers and approach lights with the LDG GEAR handle down may indicate one or more landing gear not down and locked.

2. Procedures - See NATOPS

***Sg 1, fr 3, 4***
*Landing Gear Unsafe/ Fails to Extend (One or More Gear Lights Off)*



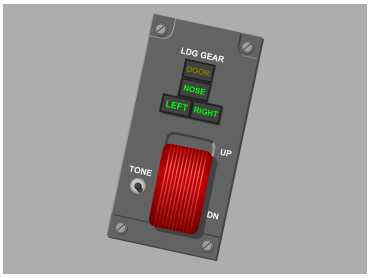

***Sg 1, fr 5, 6***
*Landing Gear Unsafe/ Fails to Extend (AOA Indexer Inoperative)*



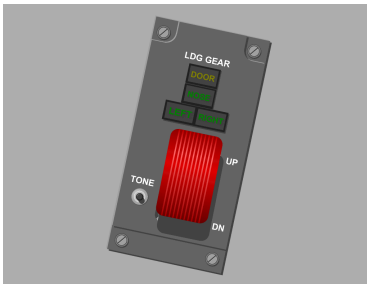

**LESSON NOTES**

*As appropriate, use the NATOPS "Landing Gear Malfunction - Landing Guide" to cover possible landing gear malfunctions and proper procedures.*

***Sg 1, fr 7, 8***
*Landing Gear Door Malfunction After Raising*



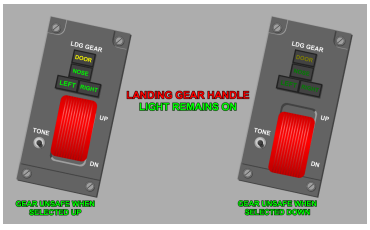

***Sg 1, fr 9, 10***
*Landing Gear Door Malfunction After Lowering*




***Sg 2, fr 2***
*Lesson Organization*

**OPERATIONAL AND LANDING EMERGENCY PROCEDURES**
* Landing gear/gear door malfunctions
* Landing gear indicator failure
* Wheel brake failure
* Blown tire
* Nose wheel steering failure
* Arrested landings

***Sg 2, fr 3***
*Landing Gear Indicator Failure*




B. Landing gear door malfunctions **1.9.3.5.1.1, 1.9.3.5.2**

**? What are the indications of a landing gear door malfunction after raising?**

ANSWER:
1. LDG GEAR DOOR light remains illuminated after gear has locked in up or down position
2. Excess noise, yawing motion, drag, or vibration increases with airspeed
3. Visual confirmation by wingman or tower personnel

1. Indications

   a. LDG GEAR DOOR light remains illuminated after gear has locked in up or down position

      NOTE: After emergency extension, the main gear door will remain open and the LDG GEAR DOOR light will remain illuminated.

   b. Excess noise, yawing motion, drag, or vibration increases with airspeed

   c. Visual confirmation by wingman or tower personnel

2. Procedures - See NATOPS

II. Landing gear indicator failure **1.8.1.8.4.2**

A. Indications: gear indicators disagree with gear handle position

B. Procedures: follow landing gear unsafe/fail to extend

III. Wheel brake failure **1.5.1.4.3.3, 1.5.1.4.3.4, 1.5.1.4.3.5, 1.5.1.4.3.6, 1.9.3.10.6**

*Sg 3, fr 2*
*Lesson Organization*

**OPERATIONAL AND LANDING EMERGENCY PROCEDURES**

* Landing gear/gear door malfunctions
* Landing gear indicator failure
* Wheel brake failure
* Blown tire
* Nose wheel steering failure
* Arrested landings

A. Indications:

1. In-flight low wheel brake accumulator pressure
2. On the deck (roll-out):
   a. Aircraft fails to slow when brakes applied
   b. Aircraft swerves after touchdown

B. Procedures - See NATOPS

1. Swerve after touchdown

*Under most circumstances, it is not considered feasible to go around with a dragging or locked brake when below approach idle power or when below 100 knots at full flaps (significantly higher speed applies when landing with a reduced flap setting). The pilot's ability to keep the aircraft on the runway is the critical factor in deciding whether to go around or stay on the deck. Without NWS, maximum rudder and braking opposite the swerve may not keep the aircraft on the runway.*

IV. Blown tire **1.9.3.11.1, 1.9.3.11.2**

*Sg 4, fr 2*
*Lesson Organization*

**OPERATIONAL AND LANDING EMERGENCY PROCEDURES**

* Landing gear/gear door malfunctions
* Landing gear indicator failure
* Wheel brake failure
* Blown tire
* Nose wheel steering failure
* Arrested landings

A. Indications

1. Unusual noise and/or vibration after touchdown
2. Rapid drift after touchdown in the direction of the blown tire

**LESSON NOTES**

*Emphasize the importance of recognizing a blown tire and quickly performing corrective control procedures.*

B. Procedures - See NATOPS

**PROGRESS CHECK**

**Question 1 — 1.9.3.11.2**
**What emergency procedure should you first consider when a tire blows on landing roll-out?**

ANSWER: Executing a go-around

*Sg 5, fr 2*
*Lesson Organization*

**OPERATIONAL AND LANDING EMERGENCY PROCEDURES**
* Landing gear/gear door malfunctions
* Landing gear indicator failure
* Wheel brake failure
* Blown tire
* Nose wheel steering failure
* Arrested landings

V. Nose wheel steering failure **1.5.1.4.2.3, 1.5.1.4.2.4**

A. Indications:

1. In-flight

a. MASTER ALERT flashes with caution tone

b. NWS caution light illuminates

2. On the deck (roll-out)

a. MASTER ALERT flashes with caution tone

b. NWS caution light illuminates

c. NWS HI advisory light goes out (if selected)

d. Nose wheel does not respond to pedal inputs

B. Procedures - See NATOPS

VI. Arrested landings **1.9.2.16.2.2, 1.9.2.16.1.2, 1.9.2.16.1.1.1**

A. Short-field arrested landing

NOTE: If a short-field arrested landing results in no engagement, consider a go-around.

1. Procedures - See NATOPS

B. Long-field arrested landing

1. Procedures - See NATOPS

**PROGRESS CHECK**

**Question 2 — 1.9.2.16.2.2**
**Where should you touch down when performing a short-field arrested landing?**

ANSWER: 500-1,000 feet prior to arresting gear

VII. Launch bar unsafe **1.9.3.12.2**

A. Indications: red L BAR warning light illuminates in flight when landing gear is lowered and launch bar is in extended position

B. Procedures - See NATOPS

***Sg 6, fr 2***
*Lesson Organization*

**OPERATIONAL AND LANDING EMERGENCY PROCEDURES**

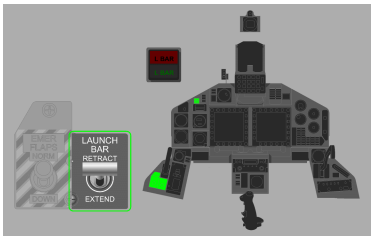
* Landing gear/gear door malfunctions
* Landing gear indicator failure
* Wheel brake failure
* Blown tire
* Nose wheel steering failure
* Arrested landings

***Sg 7, fr 2***
*Lesson Organization*

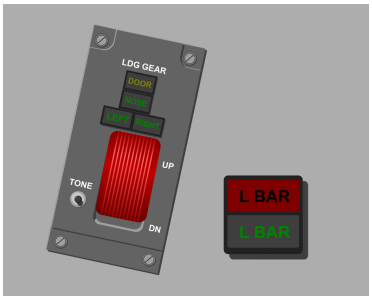
**OPERATIONAL AND LANDING EMERGENCY PROCEDURES**

* Arrested landings
* Launch bar unsafe
* Tail hook malfunction
* Anti-skid failure
* Precautionary approach
* Flameout approach

***Sg 7, fr 3***
*Launch Bar Switch and Indication Lights Location*




***Sg 7, fr 4, 5***
*Launch Bar Malfunction After Lowering Gear*

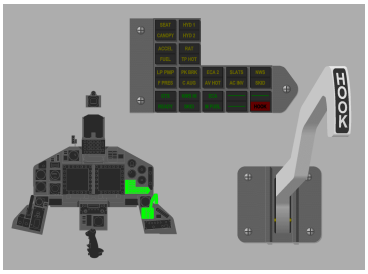


*Sg 8, fr 2*
*Lesson Organization*

**OPERATIONAL AND LANDING EMERGENCY PROCEDURES**

* Arrested landings
* Launch bar unsafe
* Tail hook malfunction
* Anti-skid failure
* Precautionary approach
* Flameout approach

*Sg 8, fr 3-5*
*Tail Hook Malfunction*

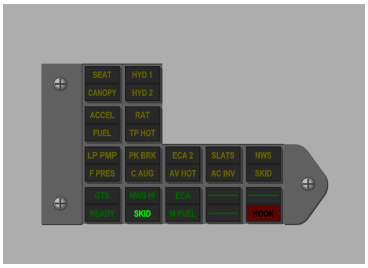



*Sg 9, fr 2*
*Lesson Organization*

**OPERATIONAL AND LANDING EMERGENCY PROCEDURES**

* Arrested landings
* Launch bar unsafe
* Tail hook malfunction
* Anti-skid failure
* Precautionary approach
* Flameout approach

*Sg 9, fr 3, 4*
*Anti-Skid Failure*




VIII. Tail hook malfunction **1.9.3.15.1, 1.9.3.15.2**

A. Indications

1. HOOK warning light illuminated (hook position does not agree with handle position)

B. Procedures - See NATOPS

**PROGRESS CHECK**

**Question 3 — 1.9.3.15.2**
**Which hydraulic system should you check if after you raise the hook handle, the HOOK light remains illuminated?**

ANSWER: HYD 1

IX. Anti-skid failure **1.9.3.9.2**

A. Indications

1. MASTER ALERT light flashes and caution tone sounds

2. SKID caution light illuminates

3. SKID advisory light goes out

4. Possible tire skidding

B. Procedures - See NATOPS

X. Precautionary approach (PA)

A. Types of approaches

1. Straight - in

2. Overhead perpendicular entry

3. Overhead parallel entry

4. Abeam

B. Use of velocity vector

1. Initiate descent when runway is under -10 pitch ladder

2. Place velocity vector just short of touchdown zone until start of flare

3. Adjust aircraft configuration to hit check points in PA

***Sg 13, fr 2***
*Lesson Organization*

**OPERATIONAL AND LANDING EMERGENCY PROCEDURES**

* Arrested landings
* Launch bar unsafe
* Tail hook malfunction
* Anti-skid failure
* Precautionary approach
* Flameout approach

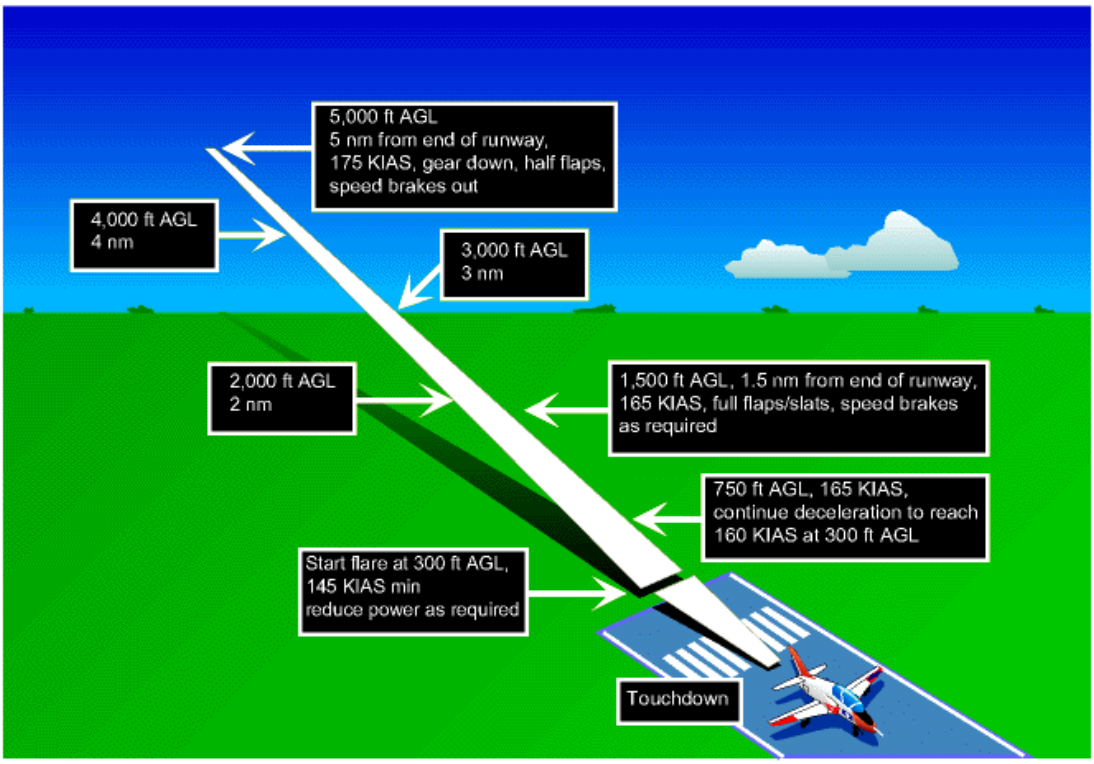
***Sg 13, fr 3***
***Fig 1:*** *Straight - in entry*

***Sg 13, fr 4***
***Fig 1:*** *Perpendicular entry*

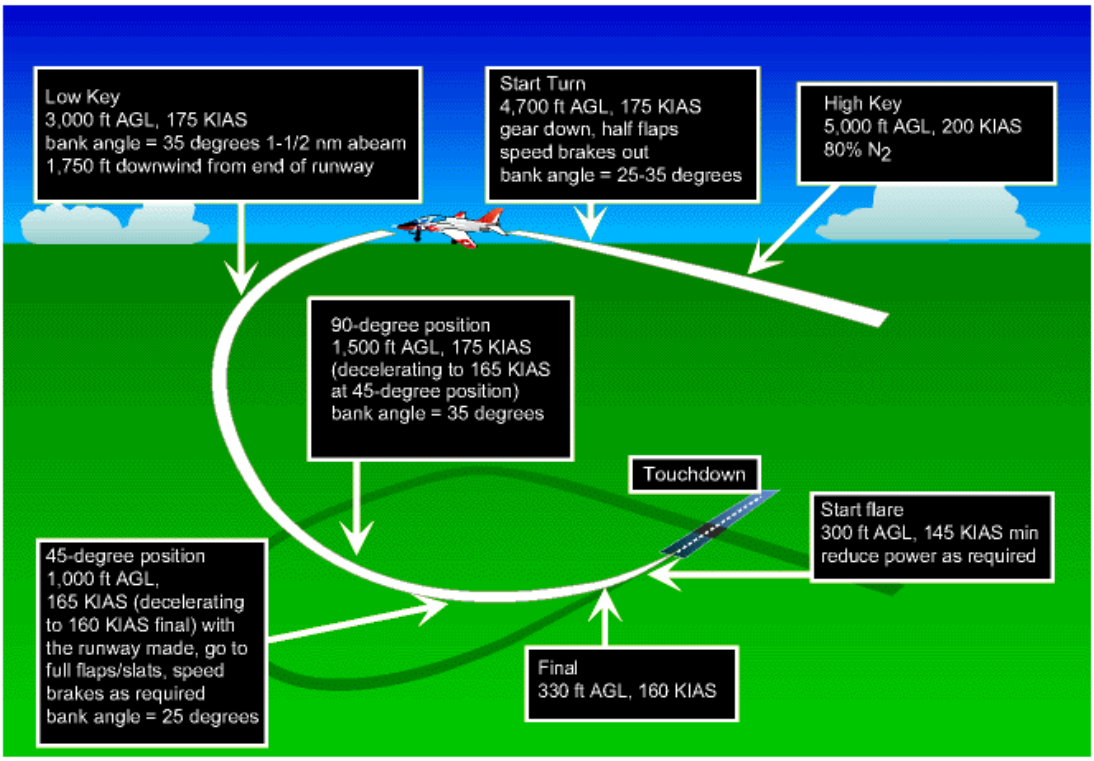
***Sg 13, fr 5***
***Fig 2:*** *Parallel entry*

***Sg 13, fr 6***
***Fig 2:*** *Abeam entry*

***Sg 13, fr 7***
*Straight - in Video*

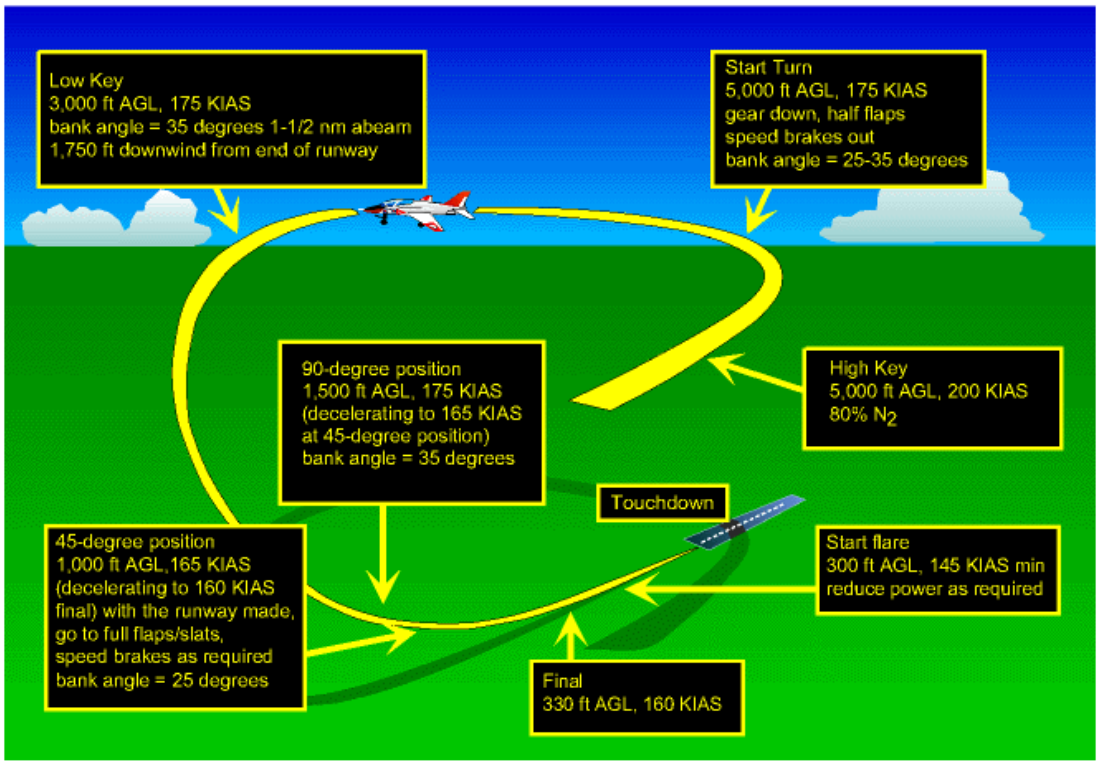



**STRAIGHT-IN**

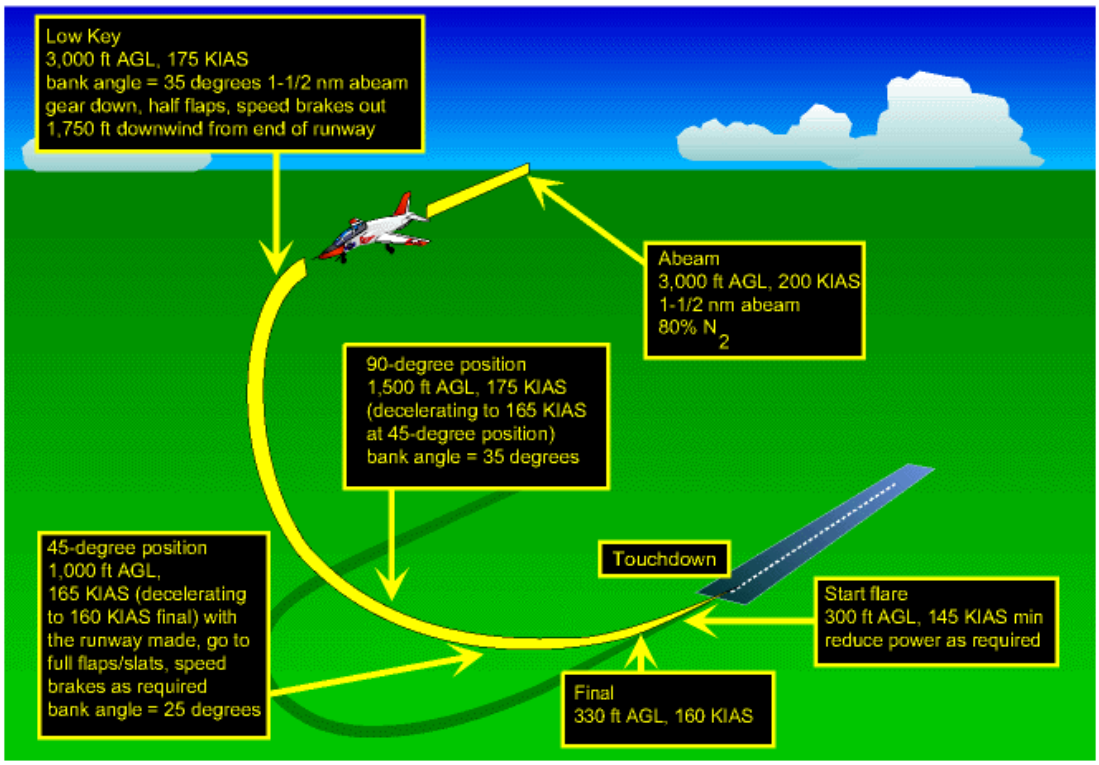



**PERPENDICULAR**

**Figure 1: PRECAUTIONARY APPROACHES**




**PARALLEL**




**ABEAM**

**Figure 2: PRECAUTIONARY APPROACHES**

***Sg 11, fr 2***
*Lesson Organization*

**OPERATIONAL AND LANDING EMERGENCY PROCEDURES**

* Arrested landings
* Launch bar unsafe
* Tail hook malfunction
* Anti-skid failure
* Precautionary approach
* Flameout approach

XI. Flameout approach

A. Indications: Fuel flow, EGT, RPM indications winding down to "0" or windmilling indications

NOTE: Flameout approaches may be attempted only when it is impossible or impractical to eject from the aircraft.

B. Procedures - See NATOPS

## SUMMARY

*Sg 10, fr 2*
*Review Menu*

This lesson presents emergency procedures for the following:

* Landing gear/gear door malfunctions
* Landing gear indicator
* Wheel brake failure
* Blown tire
* Nose wheel steering failure
* Arrested landings
* Launch bar malfunction
* Tail hook malfunction
* Anti-skid failure
* Precautionary approach
* Flameout approach

## CONCLUSION

When an emergency such as blown tire on landing occurs, you have to respond quickly and correctly to save the aircraft. You

# HOMEWORK LESSON

**COURSE/STAGE:** TS, ADV & IUT / Emergency Flight Procedures

**LESSON TITLE:** Operational and Landing Emergency Procedures

**LESSON IDENTIFIER:** T-45C TS, ADV & IUT EMFP-10

**FIGURES:** N/A

**STUDY RESOURCES:**

* T-45C NATOPS Flight Manual, A1-T45AC-NFM-000
* T-45C NATOPS Pilot's Pocket Checklist, A1-T45AC-NFM-500

**LESSON PREPARATION:**

Read:

* Emergency procedures concerning landing gear, wheel brakes, blown tires, field arrestment, launch bar, anti-skid, and flameout approaches in Chapter 16, "Landing Emergencies," of the T-45C NATOPS Flight Manual, A1-T45AC-NFM-000, and "Emergency Procedures," in the Pilot's Pocket Checklist, A1-T45AC-NFM-500

**REINFORCEMENT:** N/A

**EXAMINATION:** N/A

## MOTIVATION

This lesson is about operational and landing emergencies. The slow flight regime is about as serious as it gets. You will generally have plenty of time to troubleshoot the problem. However, some landing configurations or problems on touchdown can be extremely hazardous. Your safety will depend on your ability to handle these situations.

## OVERVIEW

The goals of this lesson are to familiarize you with the NATOPS emergency procedures for the landing phase and to prepare you for the lecture in EMFP-10.

This lesson provides NATOPS research exercises for emergencies occurring during the landing phase.

## REFRESHER

Recall the landing emergency procedures for your previous aircraft.

## PRESENTATION

NOTE: The emergency procedures required by the scenarios in the following Practice Exercises are derived entirely from Part V of the T-45C NATOPS.

### LANDING GEAR/GEAR DOOR MALFUNCTIONS

#### Landing Gear Unsafe/Fails to Extend

An unsafe gear indication may result from hydraulic failure, electrical failure, airframe damage, or a faulty gear position indicator. Unsafe gear indications should not be the only factor in the determination of an unsafe gear condition. Gear position should be determined by chase aircraft, if available, or other visual means. Maintain airspeed less than 200 KIAS and monitor HYD 1 pressure. Landing techniques differ greatly depending on the combination of up/down gear. If any gear is determined to be unlocked or up during carrier operations, your best option is to divert to shore.

#### PRACTICE EXERCISE 1

**The warning light in the LDG GEAR HANDLE will remain illuminated under the following two circumstances:**

**(1) Any _____ _____ position disagrees with the handle.**

**(2) All _____ _____ are not up and locked with the handle up.**

#### PRACTICE EXERCISE 2

**After rolling wings level out of the break, you lower the landing gear and notice that the nose gear position indicator is not illuminated. The lamp test confirms a burned-out bulb. You move up to the delta pattern, and your wingman pulls alongside and verifies all gear down and locked. Your AOA indexers are illuminated. Should you make a normal landing? (Y or N) _____**

**PRACTICE EXERCISE 3**

**Will the WHEELS light on the AOA indexer flash with the LDG GEAR handle DN and an unsafe main gear? (Y or N) _____**

**Identify and list the conditions when the WHEELS light will illuminate.**

**(1) LANDING GEAR handle _____**

**(2) Throttle _____**

**and either**

**(3) Altitude _____, and airspeed _____**

**or**

**(4) _____**

**LANDING GEAR DOOR MALFUNCTIONS AFTER RAISING/LOWERING**

Landing gear door malfunctions, even after you've raised the gear, can be serious because damage to the doors and/or connecting linkages could prevent full extension and locking of the landing gear.

**PRACTICE EXERCISE 4**

**Upon departure for a weapons flight, you raise the gear. You hear the gear come up, feel a thump, and notice that the landing gear DOOR light is still illuminated. The first thing you do is maintain airspeed below 200 KIAS and ensure the landing gear handle is _____. If the light remains on, land as soon as _____. If any gear indicates unsafe, you would execute _____ _____ _____/_____ _____ _____ procedures. A visual inspection indicates that the right main gear is unsafe. Arresting gear is not available. With proper clearances you should get rid of unexpended rockets and bombs and prepare for landing. You would use your _____ _____ Checklist and follow the instructions for right main gear malfunction found in the _____ _____ _____ _____ Guide.**

**LANDING WITH BLOWN TIRE**

**PRACTICE EXERCISE 5**

**While practicing touch and go landings at Meridian NAS, you blow a tire. On the go-around, you should place the _____ switch to OFF, monitor _____ pressure, and make a _____ field arrestment. If unable, perform a/an _____ landing. When preparing to land, you should consider landing on the _____ _____ runway. You should also land on the _____ side of the runway as the good tire.**

## SHORT-FIELD ARRESTED LANDING

### PRACTICE EXERCISE 6

**If you have a directional control problem or anticipate a stopping problem, make a short-field arrestment. Request assistance of an LSO. Lower the hook before starting the approach and get a positive hook-down check. Determine the maximum engagement speed. Your approach speed will depend on the emergency. Fly a/an _____ _____ approach to touchdown with the help of the _____ _____, if available. Touch down on _____ approximately _____-_____ ft prior to the _____. Proper pitch attitude crossing the arresting gear will reduce the possibility of a _____ _____. The optimum pitch for engagement is approximately _____ degrees of nose up pitch. The correct attitude can generally be achieved at approach power by holding _____ aft stick until engagement. Prepare for _____ if the wire is missed. If required, secure the engine and _____ the aircraft.**

## LONG-FIELD ARRESTED LANDING

### PRACTICE EXERCISE 7

**Make a long-field arrestment when there is a stopping problem (aborted takeoff, wet or icy runway, loss of brakes, etc.), and it is not possible to go around for a short-field arrestment. If the nature of the emergency results in an approach speed so fast that it will exceed the approach-end arresting gear limits, be prepared for possible _____ _____. Lower the hook in time for it to fully extend before engagement (normally _____ ft before the arresting gear). Line up on the _____. Transmit your intention to engage the arresting gear, so the tower can advise or wave off aircraft landing behind you.**

**LAUNCH BAR MALFUNCTION**

When preparing for a CAT shot, you would set the L BAR switch to EXTEND. The green L BAR light would illuminate. Once the L BAR is locked down by the CAT mechanism, the pilot selects the L BAR switch to RETRACT. At this time, the L BAR light will extinguish. In this condition, the launch bar would automatically retract after launch. If the L BAR retracts immediately after launch or when the landing gear is retracted, the L BAR light will be OUT.

The basic condition for the red L BAR light to illuminate indicating a failure of the launch bar is as follows: no weight on the wheels, LDG GEAR handle DN, L BAR switch in the retract position, and the launch bar in the extend position. There are two places in normal flight operations where you would be most likely to experience this failure. The first place is in the landing pattern when the landing gear is lowered in preparation for landing or touch and go's. The second place would be immediately following a carrier launch.

**PRACTICE EXERCISE 8**

**After lowering the landing gear on approach to Meridian, you get a red L BAR light. You (should/ should not) _____ raise the gear. You should place the launch bar switch to _____ and then get a _____ _____ if possible. With this problem, you should land _____ only and ensure that the _____ _____ are removed.**

**TAIL HOOK MALFUNCTION**

The red HOOK light illuminates any time the hook position does not agree with the handle position.

**PRACTICE EXERCISE 9**

**A. List the emergency procedures if the HOOK light remains illuminated after you lower the handle.**

**1.**_____
**2.**_____
**3.**_____

**B. List the emergency procedures if the HOOK light remains illuminated after you raise the handle.**

**1.**_____
**2.**_____
**3.**_____

**C. If you're unable to raise the hook, plan a/an _____ landing or remove the _____.**

**ANTI-SKID OR WHEEL BRAKE FAILURE**

If you have indications of anti-skid or brake failure on a runway and arresting gear is available, you should go around and perform an arrested landing.

**PRACTICE EXERCISE 10**

**If there is no response when the brakes are applied after touchdown, you should immediately _____ _____ and set up for a _____-field _____. If go-around is not feasible, you should _____ your wheel brakes, set the ANTI-SKID switch to _____, re-attempt _____, lower _____ _____ feet prior to _____ _____, and _____ off if _____ the runway.**

**SWERVE AFTER TOUCHDOWN**

Under most circumstances, it is not considered feasible to go around with a dragging or locked brake when below approach idle power or when below 100 knots at full flaps (significantly higher speed applies when landing with a reduced flap setting).

**PRACTICE EXERCISE 11**

**If swerve after touchdown is encountered, the pilot's ability to keep the aircraft on the _____ is the critical factor in deciding whether to _____ _____ or stay on the deck. Without _____, maximum _____ and _____ opposite the swerve may not keep the aircraft on the runway. If go-around is not feasible or desired, place the throttle to _____ (if departing the runway). If the aircraft begins to depart the runway, consideration to _____, obstructions, and terrain should be given in deciding to eject or stay with the aircraft.**

## SUMMARY

This lesson has provided NATOPS research exercises for emergencies occurring during the landing phase.

## CONCLUSION

One of the purposes of the hectic pace of Naval aviation training is to stress you out, to overload you with input, and to tax your ability to perform under pressure. This kind of pressure prepares you to deal with emergencies coolly and efficiently.

## ANSWER KEY

1. (1) landing gear
   (2) gear doors
2. YES
3. NO
   (1) not set to down
   (2) below 95% $N_2$ position
   (3) less than 7,200 feet MSL, less than 170 kts
   (4) FLAP/SLAT lever not set to UP
4. up, practicable, landing gear unsafe/fail to extend, NATOPS Pocket, Landing Gear Malfunction Landing
5. anti-skid, Hyd 1, short, flared, widest suitable, same
6. constant glideslope, Fresnel lens, centerline, 500-1,000, arresting gear, hook skip, 5.5, one-half, bolter, evacuate
7. tire failure, 1,000, centerline
8. should not, RETRACT, visual check, ashore, arresting wires
9. A. 1. Hook handle - CYCLE
      2. If possible, obtain a visual check
      3. Apply positive-g loads in attempt to lower hook
   B. 1. HYD 1 pressure - CHECK
      2. Hook handle - CYCLE
      3. If possible, obtain visual check
   C. arrested, CDP
10. go around, short, arrestment, release, OFF, braking, hook, 1,000, arresting gear, throttle, departing
11. runway, go around, NWS, rudder, braking, OFF, speed